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CONTENTS

ATOM - A NEW IDEA (PROJECT) OF AIRPORT SECURITY SYSTEM

Ion Toni BĂCEANU

Faculty of Aeronautical Management, "Henri Coandă" Air Force Academy, Brasov, Romania

Abstract: *The overall objective of Airport detection and Tracking Of dangerous Materials by passive and active sensors arrays (ATOM) project is to design and develop an innovative detection and surveillance system able to enhance the security level in the airport areas, by detecting hidden hazardous materials/tools (including explosives) and tracking people bringing these materials, without interfering with the normal airport operations; while directly enhancing the airport security, ATOM system will also indirectly contribute to protect aircraft (A/C) from terrorist or other criminal acts.*

Keywords: *ATOM, project, security, airport, system, detection, tracking*

1. INTRODUCTION

ATOM (Airport detection and Tracking Of dangerous Materials by passive and active sensors arrays) is based on a concept in which passengers are screened without requiring their cooperation and in which there are no security check points which passengers will have to pass through. This could mean that within the ATOM system the waiting time and the throughput of passengers are non restrictive (figure 1).

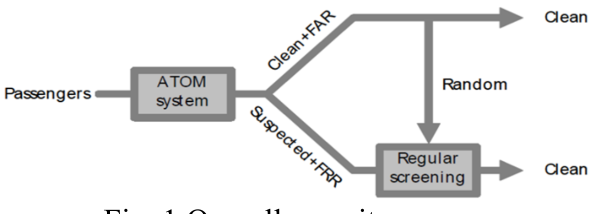

Fig. 1 Overall security process

ATOM system will be a non-intrusive but pervasive security system.

The ATOM system provides an integrated approach that allows a precise identification of threats by revealing the material, the shape and the location of the hidden item.

The ATOM system provides rather area coverage than a single point, so it does not create bottlenecks at the passenger flow. As its installation allows that the detection area remains unknown for the passengers, it does not allow easy avoidance of such points. This also means that the secure area begins at the entrance of the airport building instead of behind the security check and the WTMDs. Instead of preventing the dangerous materials and tools from airplanes and airside of the terminal it prevents such items from the entire terminal building, providing thus a wider security area (NRC, 1996).

The pervasiveness of ATOM systems derives from the capability of ATOM sub-systems of monitoring wide airport areas and of detecting many kinds of hidden hazardous objects.

The overall objective of ATOM project is to contribute to improve the security in the airport area and on board A/C by:

- detecting and identifying, without interfering neither with the normal passengers flows, nor with the normal airport operations, the presence of hazardous materials or tools, concealed (under clothes or inside bags) by ill-intentioned people circulating inside airports and that could be used for delivering attacks either against the airports themselves or against A/C;

- tracking the movements of those threatening people concealing those forbidden items, so that they can easily be localized by security operators.

In order to achieve this general objective, ATOM project intends to study, design and develop the functional prototype of an innovative system (hereinafter also referred to as ATOM system) based on a multi-sensor approach that integrates active and passive radar sensors, able to survey wide airport areas without requiring the passengers cooperation as well as to detect hazardous materials/tools and to track threatening people; this way, the ATOM system will improve the security level not only in the gate area, but at a preliminary stage, also in the Terminal area of the airport.

The technical approach that will be followed foresees two separated and integrated controls:

1. one at the airport access, equipped with devices not interfering with passengers transit and able to detect and identify tools (such as guns, knives, non-metallic weapons, explosives) concealed under clothes or inside bags, without requiring passengers to remove their clothes or to empty out their bags;
2. the other in the airport before the gate area, equipped with passive RF sensors not interfering with passengers transit and able to detect and track suspicious people.

2. OPERATIONAL AND FUNCTIONAL REQUIREMENTS

2.1 Concept of operation. A CONOP (Concept of Operation) is an important part of a security system which describes the characteristics of a system from the viewpoint of the end-user. It is a description of how the set of ATOM capabilities may be employed to achieve desired objectives or a particular end state for a specific scenario.

An important part of a CONOP is the operational concept which describes the process of screening. In the following figure a possible high level concept is described (figure 2).

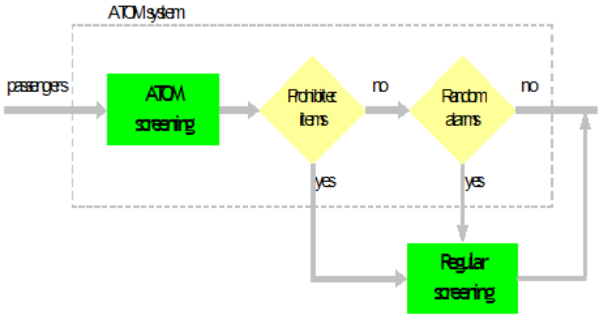

Fig. 2 Process of screening

2.2 Operational requirements. Drawings, diagrams and charts will be separated by a free space from the text and printed as close as possible to the first reference. Their width will not exceed that of the column they belong to. Should this be impossible to achieve then they will be printed across the whole breadth of the page either at the top or the bottom of the page.

Facing the on-going threat from terrorism, governments around the world have stepped up efforts to detect concealed weapons before they cause havoc at populated public settings, such as crowded subways, train station, airports, stadiums, and shopping malls. Available new technologies include chemistry-based sensors to pick up the faintest molecules of explosives in the air; passive or active screening tools to detect weapons hidden under clothes or within luggage; and artificial intelligence to go through video surveillance for suspicious behaviours in the crowd, etc. It is certain that none of the technique mentioned can serve as a comprehensive solution for such complicated problem. The diversity of technology provides different solution for specific problem.

In the following paragraphs the high level requirements will be described which should be met by the ATOM security system. This means that these requirements, describe the desired effect of the overall security process and that they are independent of the process set up. The aim is to identify the operational requirements based on the experience of airports members in consortium (Schipol and Transylvania Tg.Mures) in order to highlight the similarities and the differences.

The extent to which the security process is executed could be covered by the following objective: *Security process shall be compliant at acceptable quality level, level of perception, process times and cost* (Ashford et al., 2007).

In the current security process the throughput is used as an important indicator in order to avoid long waiting times in the event of high passenger arrival rates (figure 3).

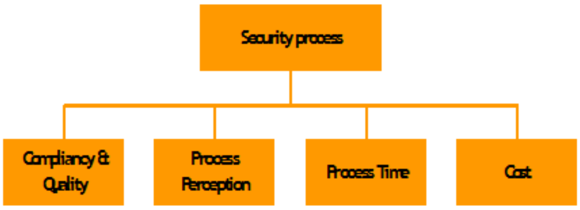

Fig. 3 Objective of the security process

Because the ATOM concepts differ from the current one and there will be no security check points, process time is used as a more general indicator instead of throughput.

Compliancy refers to the articles not permitted to carry into the security restricted area and the cabin of an aircraft. Quality is defined as the extent to which the security system is able to detect the prohibited items.

Probability of detection is the extent to which the security process complies with the EU law and regulations and to which the security system is able to detect the prohibited items.

The probability of detection of prohibited items shall be at least at the current level.

This means that the overall security process including procedures, personnel, lay-out and equipment should guarantee this detection level. If the overall security process is set up as combination of the ATOM and the regular system, then this requirement regards the overall security process (figure 1).

There will be passengers who need an additional (regular) screening due to assumption of carrying prohibited items, possession of prohibited items or due to false or random alarms. This additional screening could be executed at the regular security check points and is outside the scope of the ATOM system (see also Figure 3). However, the number of passengers which need the additional screening is affected by the reliability of the ATOM system (false alarms or false rejections) and is the subject of quality requirement of the ATOM system.

False Rejection Rate is the extent to which the passengers are wrongly suspected by the security system of carrying prohibited items (Arizona Report, 2004).

The percentage of false rejections generated by the ATOM system shall be less than 20%.

False Acceptance Rate is the extent to which the passengers are wrongly cleared by the security system.

The percentage of false acceptances generated by the ATOM system should be as close as possible to 0%.

Process perception describes the perception of passengers and security personnel regarding the security process.

Passenger Satisfaction is defined as the overall passenger experience of the security process. The following sub-indicators cover the overall passenger perception.

Passenger satisfaction regarding the security level shall be at least 76% of passengers scoring excellent or good.

Passenger satisfaction regarding the waiting time shall be at least 81% of passengers scoring excellent or good.

Passenger satisfaction regarding the security personnel friendliness shall be at least 85% of passengers scoring excellent or good.

Security personnel satisfaction regarding the operation of the security process shall be at least at the current level.

ATOM is based on a concept in which passengers are screened without requiring there cooperation and in which there are no security check points which passengers will have to pass through. This could mean that within the ATOM system the waiting time and the throughput of passengers are non-restrictive.

However, the ATOM process of detecting the prohibited items and tracking the movements of people will still claim the capacity and time of the airport security operation (also personnel) while passengers will not experience extra process time. This means that even the passengers are not aware of being screened, the security operation will need extra time for the screening of passengers and cabin bags (data processing, decision and evaluation by personnel) (Wolf, 2007).

In the next table the possibilities are shown.

Process time	ATOM screening	Regular screening
Passenger time	x	✓
Security time	✓	✓

Table 1 – Process time for ATOM screening and regular screening

In this table the only process time which will be described by a requirement is the process time of the airport security operation. Passengers will not have an additional process time in the ATOM process and the regular screening is outside the scope of the ATOM system.

The process time which airport security operation needs to execute screening of passengers and cabin bags using the ATOM system shall not delay regular passenger flow. It means that there is no additional process time for passengers.

ATOM is an innovation project which will result in a prototype of an innovative multi-sensor based system. The ATOM system could contribute to the cost objective by (partly) automating the screening process which will lower the number of personnel and decrease the exploitation costs.

The concept of ATOM system represents an integrated approach to precise detection, identification and localisation of dangerous objects such as weapons, explosives. It fuses different kinds of active and passive sensors. In the following figure the main blocks of the ATOM system are depicted (figure 4).

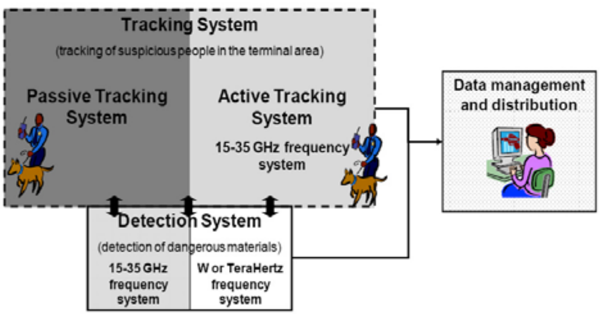

Fig. 4 Main blocks of the ATOM system

The *detection system* detects the possible threats such as weapons, sharp objects, explosives, flammable substances or chemical and toxic substances. Two detection systems are planned in ATOM which are composed of 15-35 GHz and W band detection sensors. The first is located in the airport entrance, the second in the gate entrance (Stanko et al., 2008).

The *tracking system* is activated only when the management block requires it, i.e. when it sees a possible threat in the terminal through the detection system. The initialization process comes through the communication network. The output of tracking block is the updated track of the person that is sent to the management block via the communication network. The system stops tracking when the management block requires it, i.e. when the threat has been stopped (Haegelen et al., 2008).

One requirement of the ATOM system architecture is that the ATOM sensors should not interfere with the passenger flow in order to keep the passenger satisfaction high and the time for the security inspection low. Most of the body scanner systems which are currently installed or tested on airports have a low passenger throughput because the person to be screened has to stand still during the measurement time. For this reason, in the ATOM project the scope of the W band body scanner to be developed is on the time efficiency. The special feature is that the system is able to scan moving persons, standing on moving walkways or on escalators which can be found on almost every airport. A multistatic radar, consisting of one transmitter and five receivers, rotates above the persons for getting complete 360 degree scans. During such a scan, millimetre waves (97.5 GHz centre frequency) are emitted which in the following are reflected on the person and captured again by the radar. By mechanical synchronization, radar images of moving persons can be computed using the synthetic aperture principle. Within the budget of the project, this deployment scenario was simulated by a moving wagon on a little rail system where the person stands on (see Figure 2). The passenger flow will be screened already in the public area of the terminal giving improved early risk detection. Moreover, a radar transparent screen ensures an unnoticed scanning. Different antenna configurations and setups have been tested. The weapon can be identified; the privacy is not violated at any time. Furthermore, the radar is considered as non-hazardous for the human health as the emitted energy is much less than permitted by law. For comparison: the maximum transmit power of a mobile phone is 100 times larger than the emitted power of the W band sensor.

In modern airports a large number of Wi-Fi Access Points are available which guarantee a good coverage of the area of interest. A passive radar system consists of a receiver that exploits available signals from already existing emitters to detect moving objects. This is done by comparing the received signal (containing all reflections from the surrounding area) and the clean reference signal. Thus a passive radar system does not require installation of additional emitters and does not impose any additional radiation.

A software tool for Wi-Fi passive radar operation was developed within the ATOM project. Proper models have been adopted for multipath and target returns in indoor environments.

The detections generated by the passive radar signal processing are further processed in a tracking and fusion stage to generate accurate target trajectories over time (tracks) and to combine information provided from different emitter/ receiver pairs. The passive tracking and fusion stage provides the final target localization and should preserve track identities over time. Multiple emitters and multiple receivers may be fused to obtain condensed and accurate target information.

Active tracking system: The operational band of 15-35 GHz will be used in order to obtain high cross- and down-range resolution of centimetre order along with sufficient penetration capability of the radar signal, which allows to see through clothes and meanwhile to inspect the hand-held luggage of a passenger. The centimetre level of resolution suffices for shape reconstruction of weapons, e.g. a gun, and in the meantime it respects the ethical issues of inspecting a person without showing his detailed physical features.

The UWB sensor is will deliver a high resolution 3-D image of a passenger. The aperture of UWB sensor essentially defines the effective size of a focused radar image while the operational distance should not exceed that size in order to have a cross-range resolution comparable with the central wavelength of UWB signal. Imaging of a passenger automatically includes imaging of all the objects on his body and possibly in his hand-held luggage. The imaging means obtaining of the realistic shape of an object by focusing of the synthetic or real UWB antenna array on the object. The imaging can be effectively implemented in post-processing of the acquired data based on so-called back-projection or back-propagation principles for electromagnetic waves.

Once a high resolution 3-D image is obtained, it can be visually inspected by a trained operator to detect dangerous objects from their recognizable shapes. Furthermore, a computer vision approach can be extended for their automated shape-based detection and identification.

2.3 Communication network. The goal of the communication network is to provide reliable in all circumstances link between the ATOM subsystems integrating them and finally to enable transmission of the obtained results to the Security Operators.

The overall ATOM system should work in the following way: a person moves suspiciously in an airport area → she/he is detected by the Detection block → traced by Tracking subsystem → information is Fused and transmitted through the Network to Security Operators → the person is Halted.

To enable this work process a robust and reliable communication network will be implemented. The actual network architecture and technical solution will differ according to the airport layout.

The possible layout of an airport using ATOM system can be seen in figure 5.

After entering the airport the future passenger will be scanned by the detection system, which system identifies dangerous items if any. The terminal hall will be equipped with Active and Passive tracking system which will be able to track any suspicious passenger designated by the detection system. Upon alarm situation the Security department will be notified and will be able to find and to stop any suspicious person.

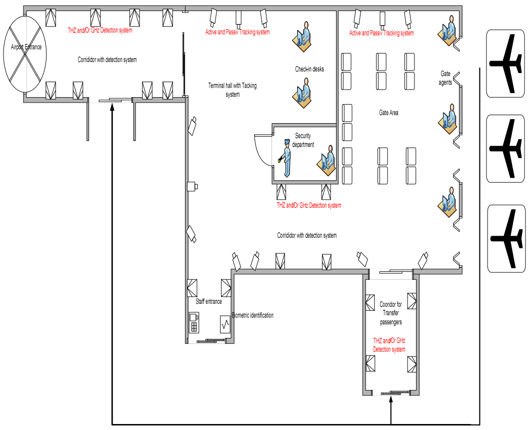

Fig. 5 The possible layout of an airport

After the check-in area the passengers (together with the transfer passengers) will be scanned again with the detection system. At the gate area a similar tracking system will be used for the tracking of the suspicious people as before in the terminal hall. Upon entering to the airport terminal the airport staff will be also scanned.

Using this method the ATOM system will be able to identify and to track any dangerous materials carried by either passenger or airport staff.

4. CONCLUSIONS

ATOM system, by developing an innovative and non-intrusive surveillance system, will enhance the security level in the gate areas and in the Terminal areas of airports.

In comparison with current security system in airport, project ATOM provides:

- Detection and tracking of different kinds of materials (not only metal);
- Improvement of the security not only in the gates area, just controlled, but also before the gates area entrances;
- Surveillance of an airport terminal area without the collaboration of the passengers;
- ATOM is able to track suspicious people inside the airport;
- ATOM foresees a command and control system for the security.

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FROM PERSONAL DEVELOPMENT TO ORGANIZATIONAL DEVELOPMENT

Sergiu-Cristian CHIRODEA, Martin, KUCHARIK, Velizar, VARBANOV

"Nicolae Balcescu" Land Forces Academy, Sibiu, Romania, Faculty of Economics and Management of the University of Defence, Brno, Czech Republic, *** Vasil Levski National Military University, Veliko Tarnovo, Bulgaria
Scientific coordinator: University Professor Doctor Stefania Bumbuc

"If you want 1 year of prosperity, grow grain. If you want 10 years of prosperity, grow trees. If you want 100 years of prosperity, grow people" Chinese proverb

Abstract: *In the age of speed and information that we live in improving it is no longer a choice, it is a must and the learning system it is not an exception, it is a vital category that has to embrace this fact.*
The paper aims to highlight the obstacles that students encounter in "Nicolae Balcescu" Land Forces Academy in Sibiu, Faculty of Economics and Management of the University of Defence in Brno, Vasil Levski National Military University in Velinko Tarnovo.

Also the paper tries to disseminate the problems and rearrange their components, so that in the end, real solutions that students and their commanders could apply reveals and hopefully the solutions will be applied in the near future.
Keywords: *learning system, problems, solutions, improving*

1. INTRODUCTION

In a world where perfection is beyond the human grasp and excellence could be reached by improving all the time, the motor of this action is a good leadership which sustains all the components of the recipe for excellence, in this case is conditioned only by the human factors of consciousness and improving.

In the next 3 chapters there will be presented weak points and strong points with solutions to improve them form three military academies in three different countries: Faculty of Economics and Management of the University of Defence in the Czech Republic, Vasil Levski National Military University in Bulgaria and "Nicolae Balcescu" Land Forces Academy in Romania .

2. "NICOLAE BALCESCU" LAND FORCES ACADEMY IN ROMANIA

Sergiu Chirodea is a student at "Nicolae Balcescu" Land Forces Academy (L.F.A.) in the city of Sibiu, Romania. He will try to identify weak points and strong points students encounter at his university. On the following lines he will point out some problems he or his friends have to deal with during his studies at his academy. It is not a complete list, but it sums up the most important issues.

2.1 The lack of time and the gaps in the schedule.

After making a non official pool, the students of L.F.A. said that the main obstacle that they encounter in the Academy was the bad organization of the activity and the lack of time. The schedule of the academy has many gaps with dead hours. A good example would be the mentoring system, we have a special class of mentoring with a person for the military or civilian, in my class I didn't saw my mentor but every time we had to stay in class.

A good solution for this problem would be if the students would evaluate better their priorities and try to make a better schedule for them. Another good solution could come from the administrative department if they would make a better schedule more close to the reality and could replace the dead hours with some practical hours that we need more from our area of study.

2.2 The organizational stress caused by the bipolar orders.

Another obstacle is the high level of organizational stress caused by the bipolar orders. Receiving a order from your commander and after a few minutes another order comes in which is in conflict with the previous order induces you an destructive and unnecessary organizational stress.

The solution to this problem is that our commanders could improve their communication, to find the best solution and to follow it, not to have two different orders for one duty that has to be done. For the students a solution is to be more flexible and more open-minded to the incoming orders and to receive them with a positive attitude.

2.3 Every Cadet.

A strong point and a good opportunity that students can find in the L.F.A. is the organization named Every Cadet. This group was founded by Vali Lupu, is promoting the high moral values, it consists of students that are learning in the L.F.A. and former students that had finished L.F.A. which now they are working in the military field. Once at every two weeks or sooner we gather and discuss about leadership and daily problems, we visit new places in the week-ends and having team building activities exceeding the level of creating a group of people and creating a family.

A good way to improve this group would be to find a way to engage all the students that are in the academy to join in at least one activity that this group has and to find a way to double the number of activities that this group has.

3. FACULTY OF ECONOMICS AND MANAGEMENT OF THE UNIVERSITY OF DEFENCE IN THE CZECH REPUBLIC

Martin Kuchařík is a student at the Faculty of Economics and Management of the University of Defence (UoD) in the city of Brno, Czech Republic. He will try to identify weak points and strong points students encounter at his university. On the following lines he will point out some problems he or his friends have to deal with during our studies at UoD. It is not a complete list, but it sums up the most important issues.

3.1 Not enough study rooms.

Many students complain about not having enough quiet and peaceful places to study. Students at our academy live in rooms for two people (with shared bathroom with another 2 students) and sometimes it is really difficult to synchronize during the exam period. One student wants to study during the day, the other wants to listen to music. One student likes to study during the night, the other one would prefer to sleep.

It is obvious that the student dormitories are not an ideal solution when it comes to study issues. The students repeatedly asked our commanders to provide us with study room and after a long time, we have been finally given a room designed only for studying.

3.2 Limited number of students sent on Erasmus programme each term.

Because of limited funds, the Faculty of economics and management sends only roughly 3 students on Erasmus study stay per term. Compared to other universities, the number is really low and there is just a small chance to be given the opportunity to study abroad. Each candidate has to undergo a series of interviews to prove his motivation and knowledge of the desired foreign institution. Based on these interviews, the level of English language (based on STANAG 6001 English language exams) and the average of all marks student has acquired during all of his studies, the students are given a score and only the best are allowed to study abroad.

Personally I agree with the system of choice, what bothers me is the small number of students that really go abroad. I think the UoD should give more money on Erasmus programme, because as we were told, money is the only limited factor here. I was among one of the happy ones who succeeded and were given the opportunity to study abroad for one term, and actually this article would not exist without this opportunity.

3.3 Not enough English (or other foreign language) classes.

It is a sad truth, that if a student did not learn a foreign language at his or her high school, there is a small chance to improve it at our university. The reason is not the teachers – they are mostly very well prepared and ready to give the students a helping hand. The core of the problem is a small number of classes – only one 90 minute block per week.

In addition students have to study English plus one other foreign language (French, Russian, German…), but with this amount of lessons per week it is merely a waste of time. The solution would be to at least double the time for learning the foreign language. That means at least two 90 minute blocks per week for each language.

3.4 Leisure Time/Sport Facilities.

On the other hand, students at UoD have a good opportunity to spend some quality free time. The gym is very well equipped with weights, weightlifting equipment and machines, including cardio part with rowing machines and exercise bikes. In the summer students can use the swimming pool, even on weekends. There is also small football pitch with running track, but it is in a really bad condition because it is used not only for practising football and running, but also for military-grade activities. All facilities have free entry.

Culture lovers can buy discounted tickets for selected concerts and theatre plays, sometimes the tickets are even free. Also there is an opportunity to visit meetings with war veterans and similar events.

4. VASIL LEVSKI NATIONAL MILITARY UNIVERSITY IN BULGARIA

Velizar Varbanov is a student at the Vasil Levski National Military University in the city of Veliko Tarnovo, Bulgaria. He will try to identify weak points and strong points students encounter at his university. On the following lines he will point out some problems he or his friends have to deal with during his studies at his academy. It is not a complete list, but it sums up the most important issues.

4.1 The administrative work (the cleaning of the university)

First of all in the past Bulgaria had a bigger army than today, so the country needed more cadets to study in the military universities. Nowadays we are fewer but the work we have to do is the same. So very often we have to work late in the afternoons to keep the university clean.

But how can we find solutions to this kind of problem? Of course the easiest way is buying machines which will help us a lot, but this method needs money and like you all know there is never enough money for such kind of innovations. So the best way to handle it is using the civilian students to clean at least their part of the university, for example in the area which is located the building where they sleep or in front of the buildings which they are also using.

4.2 Not The lack of communication between the cadets and the officers.

Another so called problem is the lack of communication between cadets and officers. You know how often you are given some order but in the same time you have another order from a different officer or you have some different work which is more important, but of course nobody cares and they want their orders to be done.

How can we handle with this problem? In my point of view the easiest way is once a week to organize meetings between cadets and officers, officers to say what should be done during the week and to decide which of the cadets have enough free time and who can cope with the tasks.

4.3 Sport clubs, events and competitions.

Now let's see one of the advantages of my university. We have a lot of sport clubs in which cadets can improve their abilities. On every floor we have a gym in which all of us can train and stay in good shape. When you are a member of these sport clubs you often take part in different sport events and competitions all over the country. You travel, see different and new things and make new friendships.

How can we improve this side of my university? Of course involving more cadets in these sport clubs would bring more winnings and cups respectively more fame and prestige for the university. But how to attract new members? The answer is easy: to provide more free time for those who are training. The question is "how?", by releasing them from the afternoon activities like cleaning and working, instead of that they could training at the sport in which they think they are best at.

5.CONCLUSIONS & ACKNOWLEDGMENT

Sergiu Chirodea:

"After the integration in NATO and EU, Romania had to align the military structures to the European standards. The road to uniformity lead our country to a period of military transformation (2008-2015).

The military learning system it is a main priority for this transformation. The academy in which I am learning is "the tip of the spear" and an excellent model for the educational system in Romania and Europe recognized by many national and international organizations, like everything it is not perfect and it has room and time for improvement. I as well as my colleagues are proud to have the opportunity be students of L.F.A."

Martin Kuchařík:

"I am satisfied with my studies at UoD, nevertheless there still are areas that can be improved. At our university there is completely anonymous evaluation of the quality of education going on each year. It is an electronic poll, where students can vote for best and worst subjects, teachers etc. Also the students can complain about any problems connected with their studies at UoD.

The poll is a tool for the responsible people to identify problems troubling most students and then to solve them. Last year, for example, most of the students complained about the absence of study rooms and this winter we have been finally provided with a brand new study room."

Velizar Varbanov:

"All in all I think that my university has a lot of minuses and even more pluses, minuses are easy to be removed and the pluses are even easier to be improved. If I could go back in time I would choose the same university and I am proud of my choice."

EXPLORATION OF MOTIVATION – SYRIAN CONFLICT

Teodora DOBRE

Faculty of Intelligence, National Intelligence Academy "Mihai Viteazul", Bucharest, Romania

Abstract: *This paper addresses the issue of the Syrian civil war, from the perspective of alliances and interests. While the revolutionary wave regressed in some countries, Syria transformed itself in a hot conflict, hosting one of the bloodiest civil wars in history. Basing their strategies on the geopolitical interests in the region, the greatest global powers find in Syria the key-element in dominating Middle East North Africa. The plan to wrest chemical weapons from Syria, shortly embodied in a UN resolution was vetoed by Russia, acting in protection of its national interest in Syria. The paper interrogates the United Nations Security Council's response to Syrian crisis and explores the Russian motivation for vetoing all attempts to impose sanctions on the Assad regime.*

Keywords: *conflict, Syria, Russia, United Nations, geopolitical interests, veto right, regional stability*

1. INTRODUCTION

Located in the horn of plenty, Syria is organized in 14 territorial provinces. From a demographic perspective, the main ethnic component in Syria is Arabic (90%), the rest of the population being constituted from Kurds, Armenians and Farsi. From a religious perspective, the majority is Sunni, followed by Alawits, Christians and Jews. (Matei Horia, Enciclopedia statelor lumii, 2011)

The Arab Spring, defined as the revolutionary wave that forever changed the face of the Middle East, started in 2010 when Mohammed Bouazizi chose to set himself on fire in sign of protest in Tunis. Shortly after, the conflict rise in Egypt, Yemen. A year later, Syrian population aligned itself with the revolutionary vision. Probably the darkest period of the Arab Spring, the Syrian civil war conjectures implications upon the major political powers. Strategically placed, Syria is the main supporter of Iran and the artery to supply the nuclear power with economic resources and military technique. Ruled by Alawits, a Shia minority, Syria represents an enemy for the Saudis, the Sunni Kingdom. The conflict seeks implications further than the obvious regional competition between Iran and Saudi Arabia. Referring to the two greatest superpowers - the political actors that defined the global security within the Cold War- Syria represents a vital element in maintaining balance in the world.

The conflict in Syria was highly unexpected. Indicators of the conflict were not identified, not even after the Arab Spring was triggered in Tunis and Egypt. Bashar al-Assad declared in an interview for the Wall Street Journal that the need for reform needs to be fulfilled before the conflict started (Russia's Sechin Defends Investment Climate, The Wall Street Journal, feb 2011). The fact that there was no unity within the existent opposition forces and a military repressive structure was dominating the society gave Assad the assurance he needed that a revolution won't start in Syria. The population was strictly controlled and showed a high degree of political conformism. The organized forces of the opposition were outside the Syrian borders – e.g. the Muslim Brotherhood. Virtually, there was no record of activities of political activism like in Egypt or Tunis. Bashar al-Assad placed his regime in the state of false security, as it is defined by Barry Buzan in the map of security (Barry Buzan, 2003). Political analysts and experts on oriental studies believe that the belief of the political leaders that conflict won't start in Syria is the one that triggered high levels of violence.

2. GEOPOLITICAL IMPLICATIONS IN THE REGION

2.1 Iran.

A geostrategic pivot in the Middle East, Syria is located central, both geographically and geopolitically. Named "the heart of the Arab nations", it is in conflict with Israel, influences Lebanon politics and represents a connecting point between Iran and Hezbollah. The revolutionary waves of the Arab Spring sought to take down regimes ruled by autocratic leaders that had the support of the Western Liberal Democracies. Bashar al- Assad creates a precedent by being the first iron fist that had Iran's support and is contested by its population. Hence, America sees in this revolution an opportunity to limit Iran's regional power (especially because of its nuclear capabilities). Assad being Tehran's main ally, his fall would determine a reduction in the power of Iran.

2.2 Saudi Arabia and the US.

Saudi Arabia is one of the most important geopolitical actors in the region and it has aligned its position to the western one, adopting at first a more reserved attitude towards the Arab Spring revolution in Syria. As the conflict perpetuated and extended, the House of Saudi chose a side: the rebels. It arrogated itself a mediation part in the conflict, becoming a "third force". Supporting the revolutionary camps through investments and humanitarian aid, Riad exploited the opportunities of this regional crisis, in order to take down the political leaders that interfered with its external policy. The fall down of the House of Assad became a priority for Saudi Arabia, who wants to include Damascus in its own influence.

The chemical attack that took place in Syria in august 2013 offered legitimacy to the United States' solution: the military intervention. Invoking crime against humanity and infringement of the human rights, America obtained international support. Obama's administration brought in the attention of the international community that when a state is no longer capable of delivering security and welfare to its citizens, and furthermore, it is the one that launches acts of violence against civilians, it is their *responsibility to protect*.

2.3 Russia.

Russia invoked its veto right on all draft propositions within the United Nations Security Council. Although the Middle East was not an area of interest for pre-soviet Russia or for the Russian Empire, this had changed once the Second World War ended. The Russian geopolitical ambitions regarded the Arab world and focused on implementing an anti-capitalist regime in the region. The Soviet Union approached stated that had similar political regimes, having as main allies Egypt, Alger, Libya and Iraq. Governments in Egypt, Syria, Yemen, Iraq, Alger and Libya showed interest towards the soviet model and the Marxist model (Walter Laquer, 1969). They became of utmost importance within the soviet policy, serving Kremlin's geopolitical purposes rather than financial ones. They accumulated enormous debts that were later erased by the Soviet Union (M. Menkiszak, 2013).

Kremlin initiated ambitious infrastructure projects, became the main investor, offered weapons and support in the Israeli conflict, but the Cuban missile crisis (1962) damaged the Russian- Arab relations significantly. The internal economic crisis that defined the politics in the Soviet Union at that time determined the revolt of the Arab states, which no longer benefited from the Russian financial aid.

Starting with 1985 and the implementation of perestroika, the role occupied by Kremlin in the Middle East quickly changed from central to peripheral. Post-soviet Russia did not have the resources necessary to nurture the relations with MENA.

Nevertheless, Syria remained an important pawn in Moscow's vision (Samuel Charap, 2013).

In 2011, Putin was reelected and was determined to continue Russia's effort to regain power and influence in the Middle East. Once the revolutionary wave was triggered, his policy became clearly defined. Russia used its veto right three times in the Security Council, claiming it wants a smooth transition to peace and considers that negotiation and mediation are the best solution, rather than military actions. Although sanctions were implemented unilaterally by the European Union and United States, Moscow maintained its position and became the mediator in the conflict. In February 2013 the first Arab-Russian Forum was organized and offered the international community the organizational frame for discussions. Even after the chemical attack, Russia remained the most important promoter for non-intervention.

When accused by the Yusef al-Qaradawi that it is quickly becoming one of the enemies of Islam, Russia decided to suspend the military support it offered to Assad's regime, by ending the supply with weapons. Kremlin intensified its international efforts in order to avoid a military intervention in Syria, similar to the one in Libya and pleaded for negotiations. It became the main mediator and convinced the House of Assad to put under international control the chemical weapons.

However, the question that remains is **WHY?** Why did Russia involve itself in the conflict so deeply and did everything possible in order to avoid the presence of foreign military on Syrian soil?

3. EXPLORATION OF MOTIVATION – The Russian Veto

3.1. The need for political stability.

United Nations resolutions induce an outcome – the change of the regime, taking down the dictator and replacing him with another one, which best served the western interests. In order to obtain stability and durability, the change must come from within. The military intervention undermines any form of political negotiation and enables armed conflict. Russia does not consider the Syrian situation justification enough to intervene in the internal affairs of another state. Taking into account the historical precedents of Afghanistan, Iraq, Kosovo, Libya, Russia considers the military intervention the perfect occasion for regional instability and conflict.

Promoter of a peaceful mediation, Russia voted in favor for sending the Arab League observers in Syria, for a better understanding of the conflict and negotiation. It is directly interested in maintaining the regional stability and although the United Stated proved their efficiency in taking down a regime, they lack efficiency in implementing a durable and stable one, which would lead to consolidation of democracy (M. Menkiszak, 2013). Furthermore, USA does not respect the position Russia occupies within the Security Council and uses the decisions of the Council as a legitimacy source for action only when they coincide with its own external policy. A conspiracy theory was launched, according to which the Washington administration triggered, coordinated and controlled the revolutions in the Middle East, through modern technological means (social media, mobile platforms) – "see what seniors managers of Google have been doing in Egypt, what kind of manipulations of the energy of the people took place here".

3.2. Beyond the commercial connections between Russia and the Middle East.

One of the most important ties between Russia and Syria regards the weapon supply.

By delivering weapons through Rosoboronexport, Kremlin does not seek to obtain economic advantages, but promoting political interests in the region. The increase in demand was not caused by the high quality weapons the Russians provided, but by their special export policies. In history, Russia used its weapons as a trade currency: frugal prices, in exchange of political support and alignment to the Kremlin's politics. After the fall of the USSR, the production and the export of weapons decreased significantly, the control Russia had upon weapons on global weapons changed from 40% in 1980 to 10% in 1994 (Center for Strategic and International Studies, Russia and Eurasia Program, 2013). The Middle East was a region defined by permanent hot conflicts, situation that required Russian attention. In the 50s, Moscow started signing agreements with Arab states, in order to obtain access to their military infrastructure. After 1989, Iran and Syria remained the only "clients" Russia had in the region.

The **Stockholm International Peace** Research **Institute** estimates that Russia obtained 162 million USD in 2009 from selling weapons to the Syrian government. The detent of the civil war and the intensification of violence in Syria only lead to an increase in demand. According to SIPRI, 78% of the Syrian weapons that were imported between 2007 and 2011 are Russian (Holly Yan, 2012). In the last year, Moscow increased the number of weapons delivered to the House of Assad, complicating the international peace efforts. The military aid offered by Moscow is beyond substantial, placing Iran on second place. Russia placed itself in an Orwellian scenario: while supplying large amounts of weapons to the Syrian regime, pleads for peace and international cooperation.

3.3. The Arab Spring – catalyzer for violence in Russia.

The Islamic victories in the Middle East resonated with the Russian Muslim population, enabling the development of an opposition force. When the Arab Spring started, Moscow showed concerns that these revolutionary waves will be the catalyzer for opposition forces within the Russian territory. The timing couldn't have been worse: the protests in Arab countries synchronized with the protests in Russia regarding the electoral fraud. Although the protests were sporadic and less powerful than in the Middle East, there were still matters to concern the Kremlin. Manifestation took place, united under one slogan: taking down the despotic regime from Russia and Tatarstan. The radicalization of the population extended in Volga region, where several political figures were assassinated - Ildus Faizov, Valiulla Yakupov. As an attempt to limit the negative effects such demonstrations might have upon the state's stability, Russia showed interest and availability in cooperating with Islamic forces. This policy extended in the area of external policy – Russia needs to demonstrate to its Islamic population (10-15 %) that it is well aware of the problem the Arab world is facing at the moment and wants to protect the interests of its citizens.

3.4. Control of the Tartus port.

The Tartus port, located on Syrian soil, is the last military base outside the former USSR and the supply base for the Russian ships in the Mediterranean. Russian diplomats classify this unity as a technical support pawn, not a military base. Established during the Cold War to support the soviet fleet, achieved great importance for the Soviets once their points of supply from Egypt, Ethiopia and Vietnam were evicted. The ships were transferred to Tartus, which became the 229th Naval and Estuary Vessel Support Division. Seven years later, it was upgraded to the status of the 720th Logistic Support Division (Zvi Magen, 2012).

In the present, port Tartus has three mobile platforms for loading, storage facilities, barracks and other facilities. The naval base was considerably extended starting with 2006, when Russia erased 75 % of Syria's debt (9.6 billion USD out of 13.4 billion USD) and became the main weapon supplier. In 2008, Assad agreed to transform the port in a permanent Russian base for warfare ships that could sustain nuclear load. Ten of these ships and four submarines with nuclear projectile were docked in 2008, and one year later a renovation project was commenced. The purpose of the project was to allow access in the port for larger ships and become both the main operational point in antipiracy war, and base for directional projectiles and aircraft carrier. During the Syrian conflict, Russia sent a Yakhont aircraft carrier, as a sign of its support (Okon Eminue, 2013; Daniel Treisman, 2013). The importance of the Tartus port is rather a symbolic one than a functional one. The Russian military forces dislocated in the region cannot face a military confrontation with an adversary. Their main purpose derives from political reasons, emphasizing the presence of Russia in the Middle East.

4. CONCLUSION

As the conflict grows, Bashar al-Assad finds it difficult to maintain power. The revolution in Syria is perceived as a Black Swan (Nassim Taleb, 2013) phenomenon. The stability of the house of Assad was ensured by the old guardians of the regime, Bashar replicating the relations of his father Hafez with members of Government. Members of his family occupy key positions, which consolidate the Ba' th party. Within the ruling elite, there is no political pressure or competition that could destabilize Bashar's privileged position (Ray Cline, C.H. Henderson, 2011).

Regarding the active military forces in Syria, they place themselves under strict control of the party. Unlike the military system implemented during Hafez's rule, now it shows a high degree of complexity. Being divided in multiple military and security units makes it impossible to take the control of the military forces. Unlike in Egypt, the military and the security services are under strict coordination of the leader of the state and their evolution depends entirely on the survival of the ruling party.

With a political position consolidated from the inside, what Bashar lacks to become a perennial dictator is external support.

Without foreign support, the rebels are just ordinary people, with zero fighting experience. The opposition, highly divided, never managed to agree upon a political choice. The y fight together to take Assad down, but after that, the struggle for power will continue and will determine violence within the forces of the opposition. They did not manage to unify their forces into one political program, and the competition determined them to lose control of occupied areas, destined for an alternative transition government. Their lack of experience in politics was proven by the naïve policy they promoted: initially refused any form of negotiation and demanded military intervention from the outside, concentrating on consolidating their relations with Turkey, Saudi Arabia and the Western Liberal Democracies (states that already supported their cause) and ignoring important social segments and factions pro-Bashar.

Russia, an old ally of the Ba'th party and a superpower with geopolitical interests in the region, makes use of its veto right to stop any form of external implication in the conflict, allowing the revolution to take its natural course and creating the conditions for Assad's rule to continue. Moscow reverted to a strategy of reasserting its sphere of influence in the Middle East and consolidating its previous connections with Syria.

The fall of the Soviet Union placed Russia in an untenable geopolitical position and the Syrian crisis might create the perfect context to change that. Putin's vision is to exploit the strong points of his state (Europe's energy dependency, political ties with states in the Middle East) and place it in a position that allows it to protect what it has and to shape the international environment in which it lives.

The vetoes inside the Security Council and the negotiations lead to avoid harsh sanctions on Assad or regime change prove that. The actions of the Kremlin, although some disguised in economic purposes, have solely a political reasoning. From denying American military intervention in Syria and the concept of responsibility to protect to making a political statement by deployment of forces in port Tartus, Russia seeks to prove its power and influence in matter of international politics.

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STUDY OF THE DYNAMIC STABILITY ON THE FLOATING STRUCTURES

Nicolae IACOB

Faculty Inginerie Braila, University Dunarea de Jos Galati, Braila, Romania

Abstract: *This paper makes a study of dynamic stability on the floating structures. It is modelling the physical and mathematical of the floating excavator, there are written the differential equations of the motion and they are solved by using SIMULINK program in the Matlab software. With the results of the amplitude, pulsations and acceleration there are ploting the graphs and there are interpreting the results. There are obtained the stability control solutions to optimize floating equipment.*

Keywords: *pulsation, amplitude, simulink, dynamic stability*

1. INTRODUCTION

Lets consider a frame that is afloat and it is bowed transverse or longitudinal inclination by the torque of external forces applied suddenly. The caused inclination is called dynamic inclination. The phenomenon is characterized by a variable angular velocity. Because the inertia frame, after touching the maximum angle it doesn't stop, but it continues to lean more and start to oscillate. Oscillations gradually go off by the water resistance force. Oscillations will decrease gradually and the machine will be return to the stable equilibrium position.

In the paper it is performed a dynamic calculation on an amphibious dredge type. This model has a displacement system designed to operate both on water and on land. Being a working excavator while floating it is analyzed the dynamic stability on the excavation process. The 3D model of the machine was realized using 3D modeling software NX 7.5 and it can be seen in Figure 1. The 3D model it was made in order to get a spatial image of an amphibious excavator.

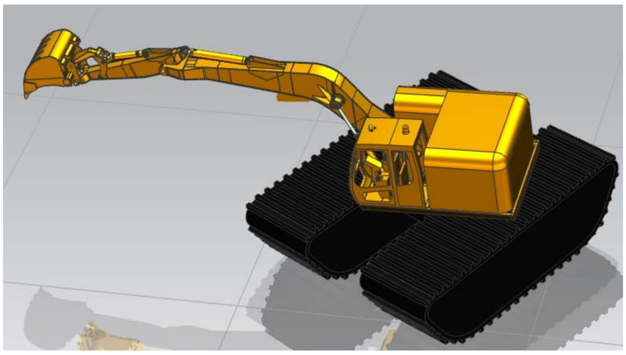

Fig. 1.1. 3D model of an amphibious excavator

2. Dynamic modeling of a floating amphibious during excavator process.

2.1. Physical and mathematical modeling

The dynamic model of the machine floatter during flotation was made after the physical model was done and can be seen in Figure 2.1.

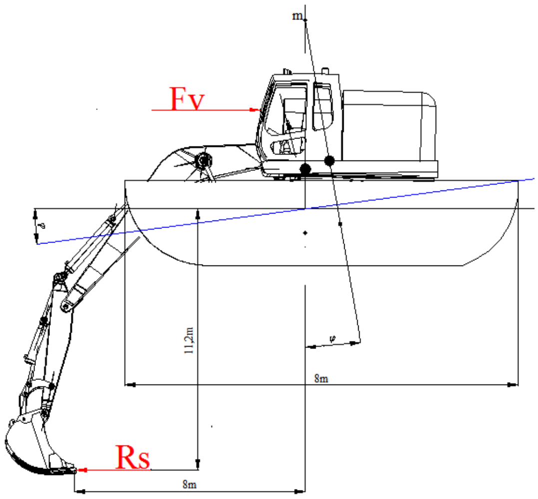

Fig. 2.1 *The physical model for calculating the dynamic stability of a floating excavator*

In Figure 2.1 lets R_S be the digging resistance forces and F_V be the wind-force. With this forces it may be calculated the disturbing moment when the float amphibious excavator can be out of balance. This disturbing moment has a value of $35000[daN \cdot m]$. When the disturbing moment is removed from the balance center of gravity, the machine starts to oscillate around the point m, with the angle φ. Shall be considered the dynamic model with two degrees of freedom (Figure 2.2), the water is described as a viscoelastic element with elasticity K = $12000[daN/m]$, and the viscous resistance c = $11.76[daN \cdot s/m]$.

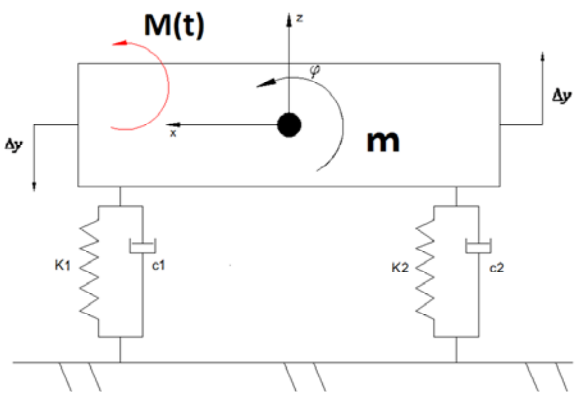

Fig. 2.2 . The dynamic model of the excavator float during float

The floating excavator is shown schematically by a rectangle shape what is placed on two viscoelastic elements. There are two viscoelastic elements because it seems to be two equal and opposite forces placed at a distance that it is called the arm stability when the machine has an inclination on the water. This may be seen on the Figure 2.3, where it is represents the scheme calculation forces during floating process.

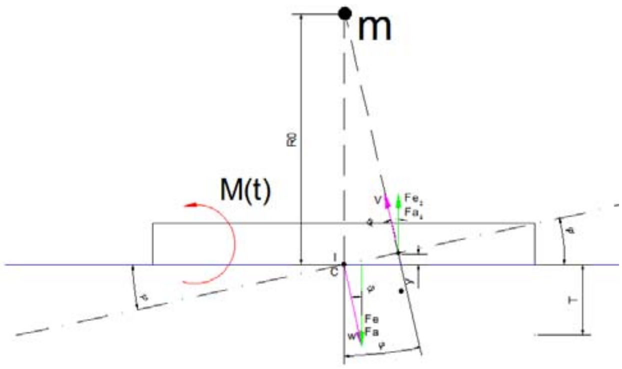

Fig. 2.3. The scheme of the calculation of the forces which occur during floating

The torque of the gravity force and the push force depends by the inclination angle φ. The two viscoelastic elements are prestressed height diving note by T. When the amphiubius excavator is taken out from the floating equilibrium under the disturbing moment, the first viscoelastic element is compressed with Δy and the other viscoelastic element is extended with Δy to the forming of the righting machine, which depends on the angle dinamic. Doing the cinetostatic analysis of the system (Figure 3.1) it can be write the equations of motion oscillatory of the amphibious excavator. The system (1) repressents the system dynamic equations of floating excavator.

$$\begin{cases} J_{yy} \cdot \ddot{\varphi} = M(t) + M_{e2} + M_{a2} - M_{e1} - M_{a1} \\ m \cdot \ddot{y} = F_{e2} + F_{a2} - F_{e1} - F_{a1} \end{cases} \quad (1)$$

2.2. Dynamic modeling calculation using the simulink program

Using the calculation program Matlab Simulink it is resolved the motion equations of the oscillatory motion created by disturbing force. Figure 2.4. shows the flowchart created in SIMULINK to solve differential equations.

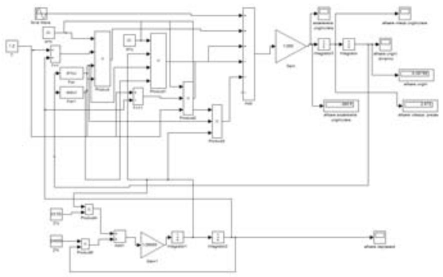

Fig. 2.4 Flowchart used to solve differential equations

2.3. Analysis and interpretation results

Solving the differential equations of motion, there will be obtained of oscillating amplitude, own pulsation and acceleration. Figure 2.5. shows the amplitude chart. The maximum amplitude which is created by disturbing force has the value 0.2 [m].

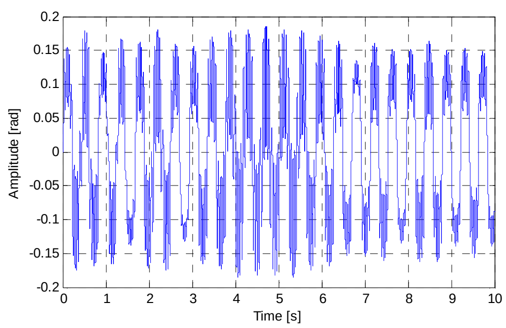

Fig. 2.5. Amplitude graph

Figure 2.6. demonstrates the output pulse chart of the amphibious excavator while it is out of equilibrium floating under of a disturbing moment. It can be seen that in the [4, 5] range it is a sudden increase in pulse. The increase of the torque due to the inertia of the machine which is greater than the torque pulsation. After that the pulsation begins to decrease due to the viscous resistance force of the water. Maximum pulsation is 14 [rad / s].

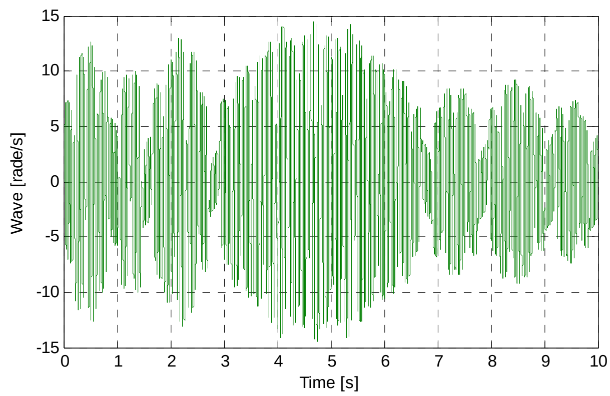

Fig.2.6. Wave graph

In Figure 2.7 it can be seen the accelerations chart.

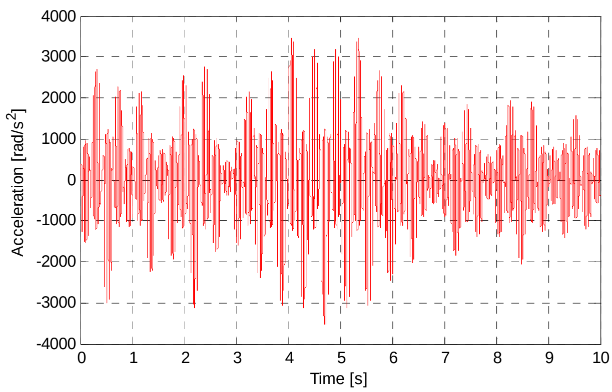

Fig. 2.7. Acceleration graph

The maximum acceleration is in the [4 , 5.5] range. During this time the machine floating inertia torque is greater than the recovery one. As it can be seen, after an interval of 5.5 seconds, acceleration starts to decrease. Dynamic model was solved to find solutions to improve the stability of floating excavators and all equipment that performs floating on the water works .
For example, a motion optimization solution is to introduce a damper floating machine

oscillations. A gyroscopic device could significantly reduce oscillations of floating equipment. It is known that when the gyroscopic moment of inertia depends on the mass in rotation, the rotational speed, and the angular velocity of precession of the angular frequency is equal to the given angle of inclination , see relation (2). Introducing the gyroscopic moment in (1) to get system (3) represents motion equations written .

$$\overline{M_G} = J \cdot \overline{\omega_r} \times \overline{\omega_p} \quad (2)$$

$$\begin{cases} J_{yy} \cdot \ddot{\varphi} = M(t) + M_{e2} + M_{a2} - M_{e1} - M_{a1} - M(G) \\ m \cdot \ddot{y} = F_{e2} + F_{a2} - F_{e1} - F_{a1} \end{cases} \quad (3)$$

Solving the system of differential equations with the same proposed method, it is obtained a movement of the floating machine with a smaller pulse. (Figure 2.8)

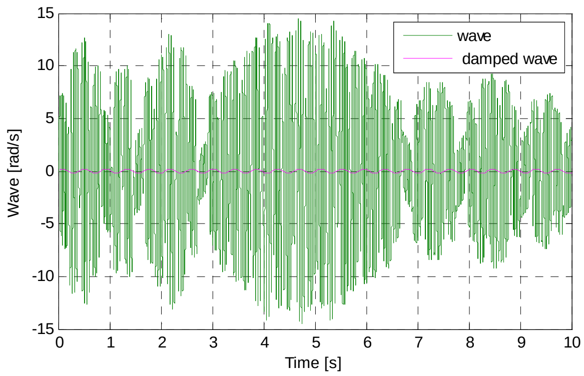

Figura 2.8 Damped wave graph

The green chart represents floating machine with no pulsation damping system, and the pink graph represent the floating excavator with a damper oscillations, which it is based on the gyroscopic moment created by on device wich generates the gyroscopic moment.

3. CONCLUSION

The study of the dynamic stability of floating equipment determined the calculation methodology that can be developed and used for all floating equipment to optimize their stability.
To solve the dynamic stability it is considered a viscoelastic medium with elastic constant equal to the product of floating surface and the specific weight of water.
The results may useful in design floating equipment to justify the gyroscopic stabilization systems equipment disturbances.

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THE EMERGENCE OF MORINT - MORAL INTELLIGENCE

Tiberiu LAZĂR, Codruț GHINEA

Faculty of Information, "Mihai Viteazul" National Intelligence Academy, Bucharest, Romania

Abstract:

The beginning of the 21st century was marked by the consequences of the most dramatic terrorist attack, by the concerns regarding the "millennium virus", by the magnitude of the economic crisis and by the emergence of the energy crises in Europe and of food crises all over the world, which generated an increased number of asymmetrical and atypical threats to the security of states and citizens.

The present fluid security climate, the changes that have occurred at the international scale and the exponential growth of threats have determined not only the will to prevent "the bad", but also a concern over the morality and ethics of human's acts. Thus, taking into consideration the fact that the authority which is in charge of administrating the sources of "bad" is the intelligence service, a wide range of discussions are centered on the moral aspects of its activity.

Intelligence is empowered to take actions in the public's interest and in the public's name that are prohibited to the public at large and, therefore, ethics become one of the main internal control mechanisms. As a consequence, there arises the necessity of studying it and exploring the ways of strengthening ethical standards.

In our opinion, the convergence of these aspects is translated into a new type of Intelligence, a type which answers to nowadays' requests and still obeys its main function of providing the consumer with the needed knowledge: MORINT (MORal INTelligence).

Keywords: *Intelligence, ethics, morality, national security, international security, values, information age, secrecy*

1. INTRODUCTION

Today, we find ourselves in the Information Age, a period of time which brought about new types of risks that transformed into constantly growing uncertainties concerning the future of European and Global security. The present threats to national, regional and global security are asymmetrical, fluid, hard to be identified and do not follow a certain already-known pattern. Thus, the intelligence services which confront them on a daily basis, felt the necessity of adapting their "modus operandi" to them.

The 21st century brought into public attention, along with the paradigm shift, the importance of human values. They are not only the ones that define the individual, but also the ones that define a whole nation, a nation which fights nowadays with completely other weapons than in the past with a view to keeping them unaltered.

Every single secret service, influenced by its particular national culture and the previous experiences, has a certain approach towards the way in which they can defend its country's core values. Therefore, even since the previous century, and more clearly post-9/11, there arose the discussions over the ethics and morality of intelligence services' activities, the possibility of them conducting moral operations, producing moral intelligence (MORINT).

The next chapters will provide an oversight over the main aspects that are in public's, organizations' and authorities' attention, in their constant struggle to reach a way of building an intelligence activity that is moral.

2. DO THEY MORALY COLLECT OR PULL OUT BY FORCE?

It is not a secret that the main activity of an intelligence service is the collection step, by which it gathers the necessary unprocessed data and information in order to be able to come to the right conclusions about a matter of interest for the national security.

This activity is divided into collection from human sources, technical sources and open sources, all of which bring about morality issues.

2.1 NOT A RED-CARPET TREATMENT FOR TERRORISTS?

Even though there are various types of human sources that an intelligence service can use, this chapter refers to the collection of information from people already associated with a phenomenon that represents a threat to the national security of the state: for example, terrorists or members of organized crime groups.

Terrorist organizations and organized crime groups represent a major threat, taking into consideration the fact that their activities put in jeopardy people's lives. Thus, the intelligence services have to perform those actions that enable them to counteract these activities.

Gathering information about those groups' intentions might be a very difficult task, because the access inside them is really restricted. Therefore, having a human source, such as a terrorist previously captured, might be a priceless asset in order to get an insight into those coordinates that are of interest about them.

Now comes the question: how can a service determine a terrorist to talk about his/her "brothers" and "their capabilities and further intentions"? The most used method, even though it seems harsh, is torture, as every person has a psychological breaking-point.

Indeed, torture is an illegal activity, not to mention that it is not moral and ethical, but even so, it is practiced because of the reasons previously mentioned.

On the other hand, thinking about the fact that, by this method, information is obtained and further life-taking actions are prevented, its purpose seems to dictate its morality. "Using enhanced torture has saved lives. It has disrupted plots."[1]

In order to understand the use of torture, we would like to summarize a subject that has been in the eyes of public for a long time, namely the secret prisons of CIA.

"On September 17, 2001, President Bush authorized the CIA to operate a secret detention program under which suspected terrorists were secretly transported to be held in CIA prisons (known as black sites) outside the United States, where they were subjected to 'enhanced interrogation techniques' that involved torture and abuse" [2] But there was only in 2006 that president Bush publicly acknowledged the existence of the secret detention program and even provided a location where this was developed: Guantanamo Bay. Besides this site, CIA also had these type of locations in Afghanistan, Lithuania, Morocco, Poland and Thailand.

Jumping in time, in December 2012, the U.S. Senate Select Committee on Intelligence voted to approve a 6,000-page report entitled "Study of the Central Intelligence Agency's Detention and Interrogation" in which the using of torture in the secret prisons is called a mistake and the further usage of it is forbidden.

Consequently, there arises an important matter of reflection. After the 9/11 attacks, the prevention of another catastrophe was

[1] Former CIA Director, George Tenet

[2] AMRIT, Singh, "Globalizing torture", 2013, p. 15

imperative and, by using secret facilities and methods like torture, this desideratum was reached. On the other hand, people who were suspected or already labeled as terrorists were held against their will and subjected to physical harm, actions which contravene international law and do not respect human's rights. Is it morally justified to torture or even kill people during the process in order to prevent the U.S.A. from being attacked again and losing numerous innocents' lives?

2.2 TECHNOLOGY - AN INTRUSION INTO PRIVATE LIFE?

The constant evolution of technology has facilitated the intelligence collection. Nonetheless, this involves high ethical problems, because any intelligence service makes use of technique in order to gain knowledge that is useful for preserving the national security. For instance, a secret service can use electronic ambient listening devices, which can be installed at a considerable distance and still be capable of intercepting a conversation. Moreover, the electronic mail and all the data received through internet connection can be monitored. The satellites can capture high-definition images from any corner of the Globe, irrespective of day time or of cloudy weather. Therefore, intelligence services are constantly using them in order to preserve the national and global security climate untouched.

There is a widely held opinion that collecting data making use of technology means implies ethical challenges, especially those which represent an intrusion into private life. This is because intelligence services use the technology to listen and record phone calls or intercept individuals' electronic mail. But how many of us know under what circumstances a phone call is listened to?

The majority would answer that the secret services are able to intercept the phone calls whenever they want to. But this belief is false, because, for example, in Romania there is a severe control over the calls' interception, which can be made only under mandatory sentence. Moreover, the mandatory sentence must be sustained with solid evidence, proving that the person whose phone is intended to be listened poses a threat to the national security. In many cases, collecting the evidence necessary to prove the need to intercept a person's calls can neutralize the proactive character of intelligence activity.

On the other hand, if the decision to start an interception was in the hands of operative officer, without being any regulations, the use of it for personal purposes and the systematic violation of private life would probably be very high.

The latest international scandal, in which Edward Snowden is the protagonist, highlighted a controversial ethical problem concerning intelligence activity. Snowden revealed operational details of a global surveillance apparatus run by the NSA, such as internet surveillance programs as well as the interception of US and European telephone data. Not only did USA spy his allies, but also his citizens in order to guarantee their national security.

A new question is raised: "is moral what America did irrespective of its means?"

3. UNWILLINGNESS TO TELL THE TRUTH?

As it has already been pointed out that there exist two major moral issues in the field of information collecting process, this chapter concentrates on a problem that arises in the steps that follow this stage: information analysis, production and dissemination.

In order to build an overall image, it is necessary to know that these steps represent the actions of filtering the information gathered through the collecting process, finding the hidden links between different pieces of information that apparently seem to have no meaning and drawing a conclusion from them. "Intelligence analysis is the application of individual and collective cognitive methods to weigh data and test hypotheses within a secret socio-cultural context"[3]. What results is named 'intelligence product', an official report that contains the explanation of facts that are of interest for the policy makers in order to make the best decisions.

One of the main imperatives of the analytic work is to look at the facts and the proofs objectively, trying not to apply any personal interference to them. The product is to be a text that presents the real situation, person or action, not to provide the perspective of the analyst over them.

The problem comes when the policy maker has a very rooted opinion over a fact or wants to make a certain decision and, because of that, he/she expects from the analyst to provide a product that confirms their thoughts. But is the mission of the analyst to impress or agree with the policy maker over a certain matter of interest for the national security?

This is a big problem of morality that manifests itself in both ways. Firstly, taking into consideration the analyst, is it moral for him to draw the conclusions that will make the consumer happy and not the ones that guarantee the preservation of national security, values or interests? Secondly, from the perspective of the policy maker, is it moral that he/she request a report that provides the conclusions that he/she wants and not one that reflects the reality?

This morality and ethics issue is very well pictured in the case of Valerie Plame, the C.I.A. non-official cover operative that suffered because of this type of altered relationship between the analysts and the policy makers.

After 9/11, large part of her work concerned the determination of the use of aluminum tubes purchased by Iraq. CIA analysts prior to the Iraq invasion were quoted by the White House as believing that Iraq was trying to acquire nuclear weapons and that these aluminum tubes could be used in a centrifuge for nuclear enrichment. This reflects the willingness of the White House that people believe the story and agree to the invasion of Iraq. But, in fact, analysts working on the case wrote in the report that the undercover work done by Valerie Plame strongly contradicted such a claim.

Because of the fact that the policy makers could not convince the analysts to provide the conclusions that implied the Iraq invasion, they proceeded to 'annihilate' Valerie Plame and change the group of analysts. Richard Armitage from the US State Department was the one who exposed Valerie's identity as a C.I.A. officer via a journalist from Washington Post. What came after was a disaster for her, because she had to resign from the service, she started to be verbally harassed through phone. In short, her life was destroyed.

And what is the cause of this laborious plan concerning Valerie? May it be the fact that she was the one that provided the analysts all the relevant information based on which the they concluded that there is no need for invasion in Iraq ? "Ms. Wilson's service may have been cut short by the failure of others to respect the classified status of her employment."[4]

Would it have been moral, from the analysts' perspective, to neglect the information that Valerie Plame had struggled to collect and draw a conclusion based only on which are the wanted answers by the decision makers?

4. TO KILL OR NOT TO KILL, THIS IS THE QUESTION

The growth of terrorist phenomenon poses severe risks to public and national security, as "an act of terrorism is an ultimate act of communication: to intimidate the target population, to rally supporters and to inspire recruits, it can also be intended to lead governments to over-react and create the conditions for revolutionary consciousness

3 JOHNSTON, Rob, "Analytic culture in the U.S. Intelligence Community", 2005, p. 4

4 UNITED STATES COURT OF APPEAL, Valerie Plame Wilson(plaintiff) v. C.I.A. (defendant), Decided 12 November 2009, p. 48

among the uncommitted"[5]. These illicit activities are placing increasing demands on secret intelligence services, whose purpose is to protect a nation from being the target of a terrorist attacks. This is because terrorism has a severe impact on the life and safety of citizens, environment, security of critical infrastructure, and well-functioning of state institutions. Therefore, a question is raised: "How can the intelligence services act in order to prevent and counter terrorism?"

In order to protect a nation against terrorist threats, particular attention is directed towards risk prevention through intelligence gathering and national and international cooperation, with a view to identifying and eliminating vulnerabilities and risk factors, to thwarting terrorists' intentions and plans, and, last but not least, to blocking expansion of terrorism from conflict areas. In other words, the intelligence services, first, must gather relevant information about possible terrorist groups and then to react proactive to disrupt terrorist planning and training.

But can a secret service neglect the moral values with the objective of protecting its nation – like killing the terrorists? One would say that every single intelligence agency has to obey the national and international laws, which involves respecting the human rights. On the other hand, for example, even though secret Israeli service, Mossad, upholds the morality as one of his guiding values, it is legally empowered to kill terrorists who threaten the Israeli nation.

A case in point would be the Operation "Wrath of God", also known as "Operation Bayonet", which was a covert operation directed by the Mossad. Its purpose was to assassinate the individuals suspected of being involved in the 1972 Munich massacre, in which 11 members of the Israeli Olympic team were killed. Israeli Prime Minister Golda Meir created "Committee X", a small group of government officials, tasked with formulating an Israeli response. "The Committee" came to the conclusion that, in order to deter future violent incidents against Israel, they needed to assassinate those who had supported or carried out the Munich massacre.

Can we imagine that assassination is the single "antidote" to terrorist activities? From the Israeli point of view, this alternative seems to be legitimate, as, through it, they punish and eradicate the terrorist groups. Conversely, killing seems to be a cruel alternative, which violates the human rights. Moreover, cognitive biases can arise and, as a consequence, innocent people may be considered or associated with terrorist phenomenon and may be unjustly killed.

[5] SIR OMAND, David, "Ethical guidelines in using secret intelligence for public security", 2006, p. 395

5. CONCLUSIONS & ACKNOWLEDGEMENT

The changes in the nature of threats, the shift from state actors to non-state actors, the fluid security climate, the multi-polar organized world have all determined the intelligence services to adapt their means. Some of them are moral, others are immoral or unethical, but the final result of the application of those means is, in almost all cases, a good one: preventing a threat that could put people's lives or country's values and interests in danger.

Moreover, the 21st century brought about the need of transparency concerning the intelligence activity and also numerous discussions over morality and ethics in different activities. Secret services, in order to adapt to the international context, started both a real cooperation with foreign structures over matters of mutual interest and an opening to the public, in order to reach that desired transparency.

Consequently, people all over the world began to understand better what do these types of structures do and what had been some of their previous missions and cases. Therefore, by combining the widespread concern previously mentioned with the opening towards the public, there arose the big problem of the morality of intelligence activities such as: violent interrogation techniques, tapping the phones, committing homicide or even giving the policy maker what he/she wants to hear.

Should there be no moral barriers for intelligence services and, thus, they could use any means for preserving the national security and people's security? Or should the intelligence services obey to a set of morality rules and principles and risk missing a piece of valuable information because of the restricted number of means available?

Does the end justify the means?

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DESIGN AND CONSTRUCTION OF A TAIL-SITTER VTOL FOR INDOOR

Florina-Ioana MĂHĂLEAN

Military Technical Academy, Integrated Systems of Aviation, Geomatics and Mechanics, Bucharest, Romania

Abstract: *The paper presents one attempt in building a tail-sitter VTOL for indoor, designing the most suitable model for reaching the goals. The model is made in different designing programs and the obtained products are used in simulation programs for obtaining the aerodynamics coefficients. The paper also presents the construction of the real model, materials used and the steps of the construction.*
Keywords: *UAV, stability, design, 3D model, CATIA, light materials.*

1. INTRODUCTION

UAVs (Unmanned Aerial Vehicles) have been a part of the aviation since decades. The first notable historical attempt was in 1916, A. M. Low's "Aerial Target". Since then, the technology gas reached a whole new level, offering the opportunity to create a various range of unmanned aerial vehicles differentiated not only by scale but also by the operating principle, or the mission they accomplish.

UAVs can be classified according to the tasks performed:

- Target and decoy – providing ground and aerial gunnery a target that simulates an enemy aircraft or missile
- Reconnaissance – providing battlefield intelligence
- Combat – providing attack capability for high-risk missions (see Unmanned combat air vehicle)
- Logistics – UAVs specifically designed for cargo and logistics operation
- Research and development – used to further develop UAV technologies to be integrated into field deployed UAV aircraft
- Civil and Commercial UAVs – UAVs specifically designed for civil and commercial applications

UAVs structure varies from the classical plane structure to newer models like quadcopters, hexacopters etc. The Mini-UAV shown in this paper has a hybrid structure, being a mix between a plane and a helicopter. Due to the fact that is an indoor UAV it must be capable to fly in tight places, hence the hovering ability. It can perform vertical take-off and landing (VTOL) and also a variety of aerobatics.

2. DESIGN

The novelty of this air vehicle is that it combines several features from conventional aircrafts. The rationale of establishing most outstanding features from these vehicles on a single UAV design is manly to improve weaknesses of one and another.

Because it has VTOL capability, it can take off and land vertically. It can also hover, fly forward, backward and pirouette at any time during the vertical flight. The UAVs capabilities are extended to the ability to rotate the whole body about 90^{o} and enter in horizontal flight while hovering. For landing the UAV performs a reverse manoeuvre, and descends smoothly to the ground.

Because of all this requirements the UAV has a unique design specially conceived to accomplish all of them.

The 3D model of the UAV was made in design programs as CATIA V5 and GMSH, programs that are useful because the model can be exported in different formats and used in other simulation program for experimental tests.

In CATIA V5 were created the sketches and the 3D model. On this program we introduced the materials used for building the real UAV and so we obtained the center of gravity (CG) and the inertia moments that, needed for calculating the stability of the UAV.

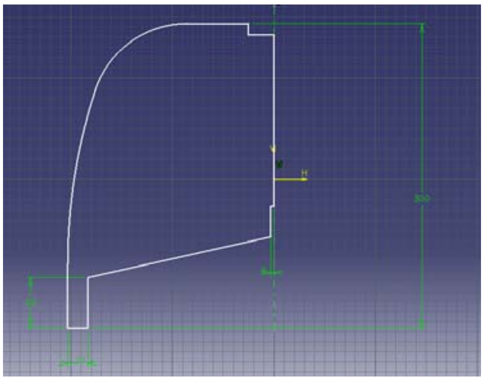


Figure 1- Wing design in CATIA

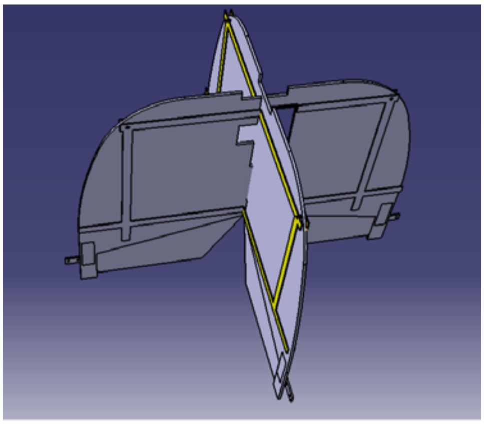


Figure 2- 3D model in CATIA

Other program used is GMSH and the model designed in this program is meshed and can be used in simulation programs as FLUENT.

3. CONSTRUCTION

A. Materials used

The materials used were considered to be light so that the engine and the propeller could accomplish the mission. Also the materials have good resistance.

The wing will be constructed using 3mm thick Depron foam, strengthened with Oracover, a self-adhering microfilm material and a truss structure constructed using carbon fibre of 1 mm, 1.5 mm and 3mm in diameter.

➢ Depron: is an expanded polystyrene with fine granulation available commercially in sheets of standardized size. It was originally designed as a phonic and thermal isolator, but because of its resistance and low density, it has become a very popular choice amongst the modelling industry. The table below present the mechanical characteristics of this material:

Parameter	**Specs**
General Information	
Material	EPS
Thickness	3 mm
Colour	white
Density	33 kg/m3
Mechanical Properties	
Compressive Stress (@ 10% deformation)	0.15 MPa
Tensile Stress (@ break, longitudinal)	1.30 MPa
Tensile Stress (@ break, lateral)	0.70 MPa
Elongation, longitudinal	9%
Elongation, lateral	12%

Figure 3- Mechanical characteristics of Depron

➢ Oracover: is a thermo adhesive polyester microfilm used for wing covering. A special property of this material is the fact that it shrinks when subjected to heat. Therefore it can provide a perfect covering material without any veiling or air pockets. The adhesive is activated at a temperature of only 80°C, a temperature that is low enough not to damage the foam. The mechanical

Parameter	Specs
General Information	
Material	microfilm, thermo adhesive polyester
Thickness	approx. 45-65mm
Colour	White
Density3	80g/m2
Mechanical Properties	
Tensile Strength (lengthwise/crosswise)	min. 283N/50 mm
Breaking extension (lengthwise/crosswise)	min. 90%
Adhesive power	min. 10N/25 mm
Shrinkage	min. 5% in both directions

Figure 4- Mechanical characteristics of Oracover

- Carbon fibre is composed of carbon atoms bound together to form long chains. The fibres are extremely rigid, strong and lightweight. To create the composite material the carbon fibres that are rigid to traction and compression need a matrix to keep them together. Epoxy resin, is an excellent material that behaves well both to compression and shear. For these reasons it is commonly used as the matrix material.

Carbon fibre is a very lightweight material and has a relatively reduced density compared to its strength. It is, for example, more resistant than Aluminium. The mechanical properties of carbon fibre can be observed in table below:

Parameter	Specs
General Information	
Material	Carbon fibre, rod
Density	
Mechanical Properties	
Elasticity Modulus	138 GPa
Ultimate tensile strength	3,5 GPa

Figure 5- Mechanical characteristics of carbon fibre

B. Wing structure

To obtain a viable aerial vehicle, choosing the wing is very important. Considering the capabilities that should be obtained it was decided to use a delta wing. The delta wing is a wing platform, in the form of the triangle. It is named for its similarity in shape to the Greek uppercase letter delta. The delta plan form gives the largest total wing area (generating useful lift) for the wing shape, with very low wing per-unit loading, permitting high manoeuvrability in the airframe. Condition for the wing to have also relatively good properties at low velocities (sufficient lift and not too large angle of attack) leads roughly to the condition that b/l (b semi span and l length) is approximately 0.25 and certainly not considerably smaller than 0.2. The wing for Mini-UAV was built from 3mm thick Depron foam, a closed cell Styrofoam foam in sheet form which is a fantastic medium for building model aircraft. It is light and strong enough for light electric motor battery set ups. The aircraft was built using 2 wings assembled in a cruciform structure. For assembling were used small PVC strips and plastic screws and nuts.

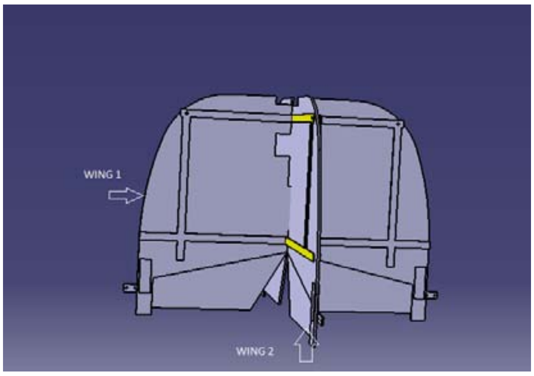


Figure 6- Wing assembly

C. Wing resistance structure

The wing will be strengthened with 1 cm wide strips of Oracover. The resistance of this material and the ease with which it can be applied makes it an excellent choice for the task. The model presented in this rapport represents the 4th version of the UAV in terms of structure. The Oracover microfilm adheres excellently to foam and two 1cm strips of Oracover are lighter than 1 mm diameter carbon fibre of the same length.

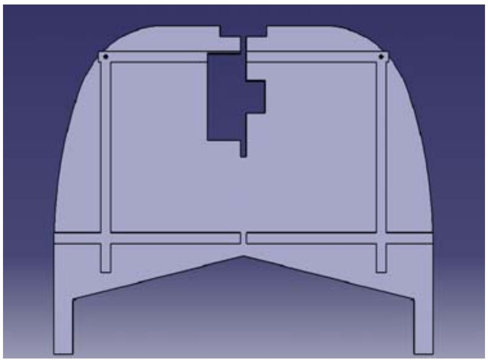


Figure 7- Wing resistance structure

To strengthen the structure even further and to give it greater stability, 1.5 mm and 3 mm carbon fibre has been used to create a truss structure. Two such structures have been created. The extra weight added is minimal and the structure becomes significantly more resistant. First structure is created from 1.5 mm carbon fibre and is placed inside the wings. The carbon fibre is glued on plastic connectors place at 40 mm from top and 100 mm from center. The second structure is made from 3 mm carbon fibre placed outside the wings, using plastic connectors glued on the foam.

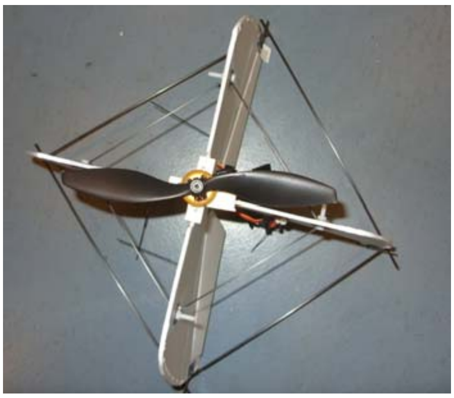


Figure 8- Wing resistance structure

D. Attaching the motor and the propeller

The motor is attached using 3 2M steel bolts on 4 mm thick plywood.

The propeller is attached using a rubber band. This system of attaching the propeller to small motors is called „Prop Saver. It was invented by Claus Urbach and it is designed to „save the propeller and motor shaft in case of a violent landing.

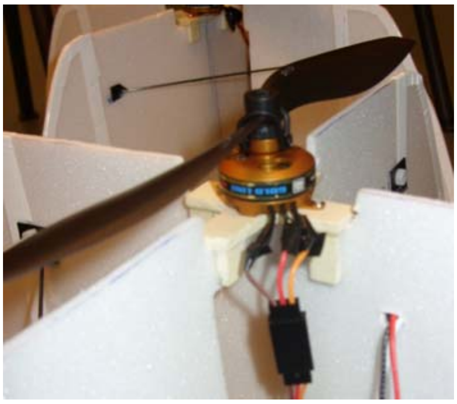


Figure 9- Motor and propeller position

E. Control surfaces

The control surfaces have been designed in such a way that they can cope with all the stability and control requirements of the aircraft. Therefore, each control surface has an approximate size equal to one fifth of the

total wing surface. They have both the elevator and aileron effect, a mix called 'elevon'

Figure 10- Control surfaces

4. STABILITY

A. Generalities

Stability is the inherent quality of an airplane to correct for conditions that may disturb its equilibrium, and to return or to continue on the original flight path. It is primarily an airplane design characteristic. Stability of an airplane in flight is slightly more complex than just explained, because the airplane is free to move in any direction and must be controllable in pitch, roll, and direction. There are two types of stability: static and dynamic.

Static stability- the initial tendency that the airplane displays after its equilibrium is disturbed. We can have positive, negative or neutral static stability as shown below:

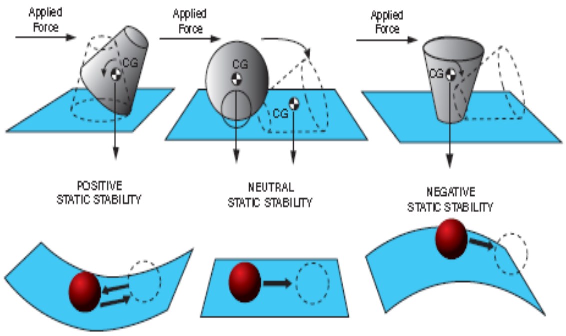


Figure 11- Static stability

Dynamic stability- the overall tendency that the airplane displays after its equilibrium is disturbed.

Longitudinal stability is the quality that makes an airplane stable about its lateral axis. It involves the pitching motion as the airplane's nose moves up and down in flight. A longitudinally unstable airplane has a tendency to dive or climb progressively into a very steep dive or climb, or even a stall. The longitudinal static stability of an aircraft is significantly influenced by the position of the center of gravity of the aircraft. Such potential CG adjustments are typically imagined as increments forward or aft from the "aerodynamic center" of the wing which is a position, typically near 1/4 chord aft of the leading edge, where changes in angle of attack do not change pitching moment. The pitching moment is not typically zero there, just constant.

B. Calculating the center of gravity

Center of gravity (CG) is positioned at 25% of Mean Aerodynamic Chord (MAC). MAC is the chord of a rectangular wing, which has the same area, aerodynamic force and position of the centre of pressure at a given angle of attack as the given wing has. It is defined as:

$$MAC = \frac{2}{S}\int_0^{\frac{b}{2}} c(x)^2 dx \quad (1)$$

-x is the coordinate along the wing span;
-c is the chord at the coordinate x;
-S is wing surface;
-b is wing span.

Starting from the mathematical description of the ellipse:

$$\left(\frac{x}{a_1}\right)^2 + \left(\frac{y}{b_1}\right)^2 = 1 \quad (2)$$

-a_1 and b_1 represent the semi axis of the ellipse, we obtain:

$$y = \frac{b_1}{a_1}\sqrt{a_1^2 - x^2} \quad (3)$$

$$MAC = \frac{2}{S}\int_0^{\frac{b}{2}} \left(\frac{b_1}{a_1}\sqrt{a_1^2 - x^2}\right)^2 dx \quad (4)$$

$b_1 = 30[cm]$,
$a_1 = 20[cm]$,
$\frac{b}{2} = 20[cm]$,
$S = 2320[cm^2]$

$MAC = 12{,}371\,[cm]$ position on y axis.

Drawing the MAC on the wing we obtain the length of MAC on y axis:

$MAC = 29{,}2029\,[cm]$

The center of gravity:

$CG_1 = 25\%MAC = \frac{1}{4}29{,}2029 = 7{,}3023\,[cm]$;

Projecting it on Oy we have

$$CG = 30 - MAC + CG_1 = 8{,}0994[cm]$$

Component	Weight (g)	Position on x axis (mm)
Battery	31	80,994
Motor	20	9,75
Propeller	4	-15
ESC	9	75
Receiver	4	130
ArduPilotMega (APM)	50	80,994
Servo(x4)	4 x 7,6	120
Wing	26	130,655
Reinforcements	5	
Total	179,4	
CG position	80,365	

Figure 12- CG positioning

C. Equipment positioning

The equipment will be positioned so that the centre of gravity of the UAV will be at exactly 25% MAC or 80,994 mm from the tip of the wing on the y axis.

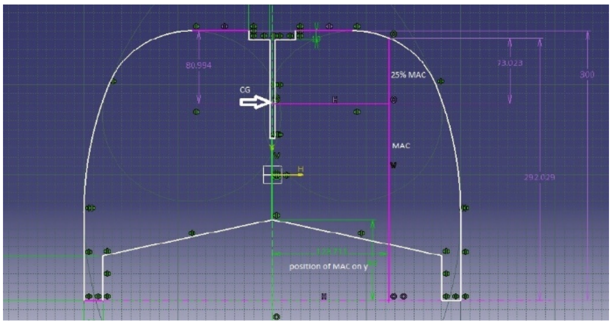
A first observation is the fact that several components have a predefined position which cannot be changed in order to move the centre of gravity. These are as follows:

1. The propulsion system (motor + propeller) will be placed in front.
2. The autopilot board (APM), which contains the microcontroller and sensors is recommended to be placed as near to the centre of gravity as possible. This position is recommended by the manufacturer and is the position that delivers the best results. Therefore the board will be placed exactly on top of the CG.
3. The servos and receiver will be placed as close to the APM board as possible to reduce the required length for connecting cables.
4. The speed controller (ESC4) will be placed close to the motor, in order to shorten the connecting cables.

The CG position will be calculated as follows:

1. The total mass of the components is calculated $m = \sum_{i=1}^{n} m_i$, where n is the number of components;
2. The moments with respect to the reference point are calculated:

$$M = \sum_{i=1}^{n} poz_i \cdot m_i$$



3. The position of the CG: $CG = \frac{M}{m}$

Figure 13- Components' position

5. CONCLUSIONS AND FURTHER ACTIONS

The work that has been done so far is a beginning for the big project, to create at least 4 or 5 UAVs for indoor. Each model will have the required equipment so that it can fulfill its mission inside the building. This part is very important because it established the design, the stability of the UAV with all the required equipment.

Further, the model created will be used for tests, real or virtual, that will give us the aerodynamics coefficients for the flight requirements that tell us if the UAV can or cannot work as we need and also solutions for improvement.

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EXPERIMENTAL SAR (SPECIFIC ABSORPTION RATE) MEASUREMENT FOR A GSM MOBILE PHONE

Andrei PAHOMI

Faculty of Aeronautical Management, "Henri Coanda" Air Force Academy, Brasov, Romania*

Abstract: *Specific Absorption Rate (SAR) is the unit of measurement for the amount of Radio Frequency (RF) energy absorbed by the body when for example using a mobile phone, walkie talkie, or working in very close to radio communication transmitting antennas. SAR is expressed in units of watts per kilogram (W/kg). Specialised laboratory test equipment is used for conducting SAR measurements. The equipment consists of a 'phantom' (human or box), precision robot, RF field sensors, and mobile phone holder. The phantom is filled with a liquid that presents the electrical properties of human tissue. In this paper I will present an experimental method to measure the SAR. This method uses a software called Ansoft HFSS 12 which allows the construction of various types of antennas and the measurement of their parameters (the measurement of Specific Absorption Rate for example). This paper describes the SAR measurements for three GSM dipole antennas that work with standard emission frequencies, using the Ansoft HFSS 12 software.*

Keywords: *specific absorption rate, mobile phones, SAR measurement, Ansoft HFSS 12*

1. INTRODUCTION

This paper aims to show a simple experimental way of measuring of the Specific Absorption Rate (SAR) for a GSM mobile phone in accordance with the specifications of P1528-2002 IEEE standard.

For this simulation I used Ansoft HFSS 12 software. The *High Frequency Structure Simulator* allows the designing of high-frequency and high-speed electronic components. This software is very accurate and reduces the costs of practical measurements.

The frequencies at which I have designed simulations were 835 MHz, 880 MHz and 915 MHz. These values represent transmission frequencies used by the mobile phone GSM service.

2. ANTENNA DESIGN

Firstly, we need to choose the measurement units: in our case we will work with millimeters (figure no.1).

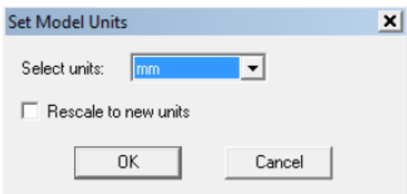

Fig.1. Units selection

Antenna will be made of a perfect conductor material: from Select Definition window we will select the PEC predefined material (figure no.2).

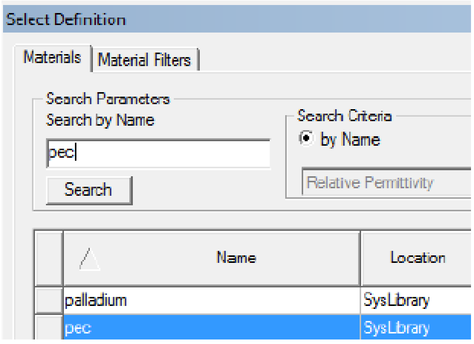

Fig.2. Antenna material selection

The next step is building a dipole antenna using the PEC material. The dipole has a length of 150 mm and a diameter of 4 mm. The feeding gap size is 2 mm (figure no.3).

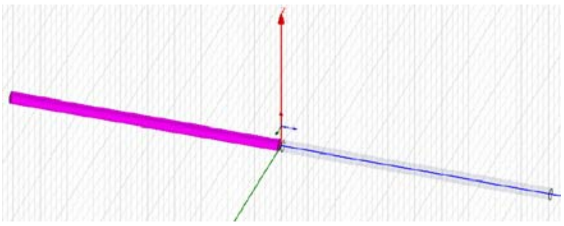

Fig.3. Dipole antenna drawing

We define the port through which antenna is supplied: we will use a Lumped port because it works in a slot (between the two sections of the line) – (figure no.4). We will assign it a resistance of 50 ohms (figure no.5).

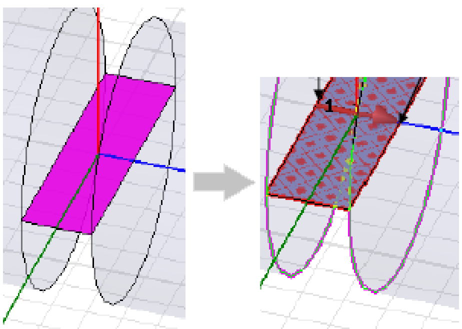

Fig.4. Lumped port definition

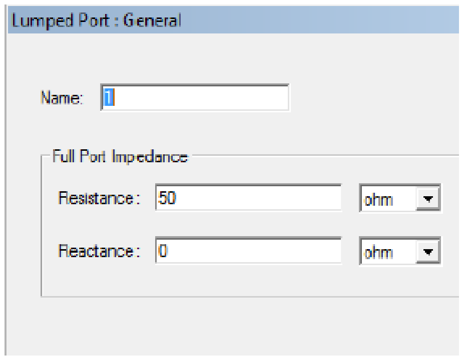

Fig.5. Resistance assignment

3. HUMAN HEAD AND BRAIN DESIGN

In order to design the human skull we have to define a new material that will have a relative permittivity of 4.6 (figure no. 6).

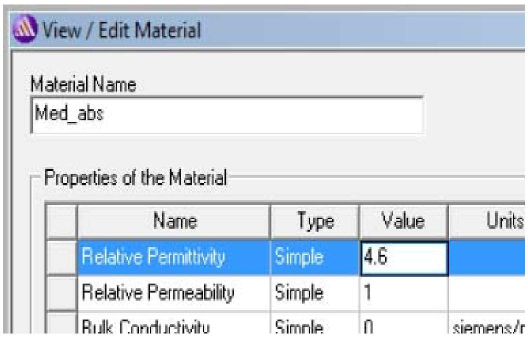

Fig.6. Skull material definition

We draw the human skull using the material previously defined: we will draw a sphere with a diameter of about 22 centimeters (a normal value for a human skull) – (figure no.7).

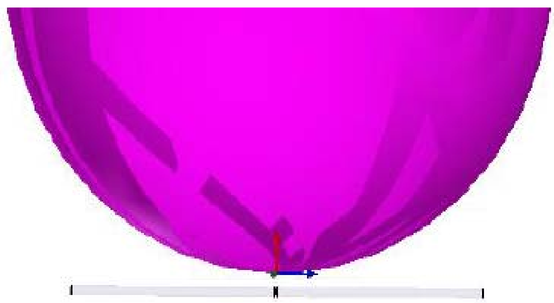

Fig.7. Human skull drawing

Inside this sphere (human skull) we will insert another sphere (which will represent the brain fluid) to simulate the absorbing effect of the brain. For this we need to define a new material characterized by a relative permittivity of 42.9 and a bulk conductivity of 0.9 siemens / m (figure no.8).

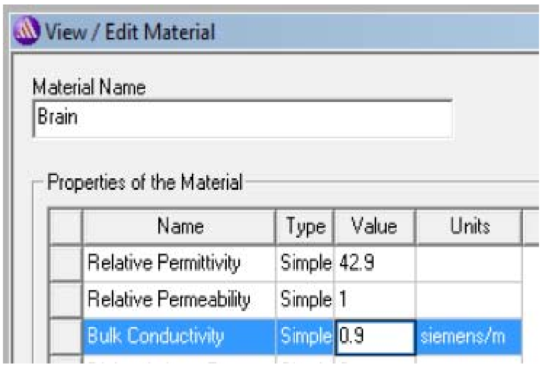

Fig.8. Brain material definition

We draw the brain fluid inside the skull (figure no. 9):

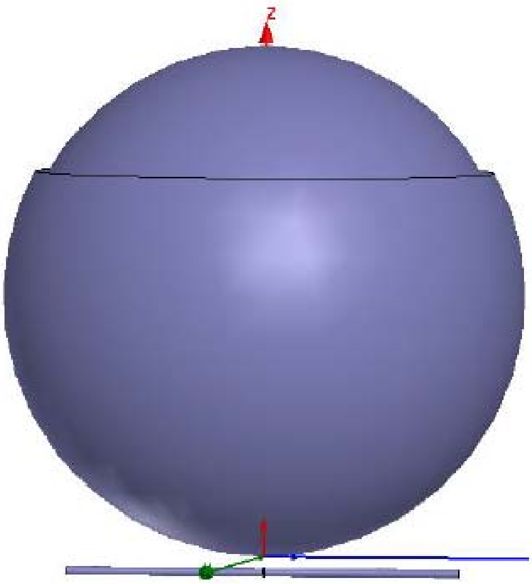

Fig.9. Brain fluid drawing

The two materials must not overlap (this is not allowed because one material is conductive), therefore we will use the subtraction function (figure no.10):

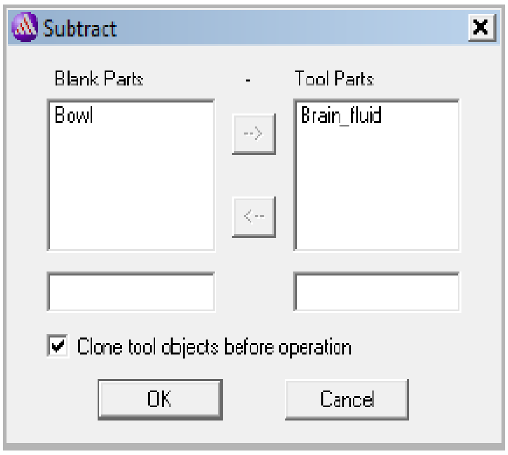

Fig.10. Subtraction of the brain fluid

To better observe what happens in the brain during the simulations we will remove some brain fluid (figure no.11):

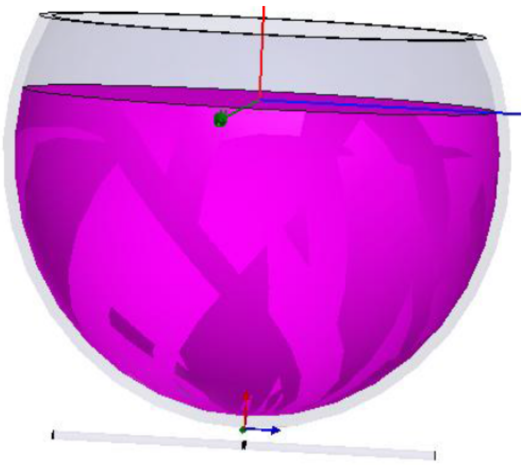

Fig.11. Removing part of the brain fluid

To get a more accurate representation of the simulations we will add a network of sensors which will be arranged along an imaginary line that enters through the brain fluid perpendicular to the antenna (figure no. 12).

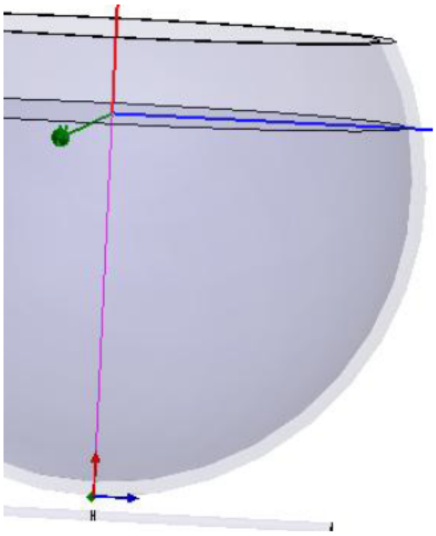

Fig.12. Adding the sensors

Next, we draw the transmission medium around the human head (a box made of vacuum) – (figure no.13).

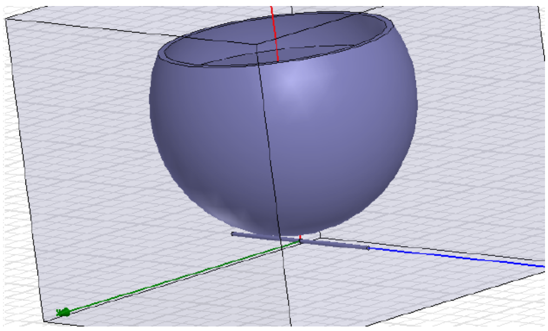

Fig.13. Drawing the transmission medium

3. SAR MEASUREMENT

We will define a radiation / radiation area (far-field representation) in the transmission medium (figure no.14).

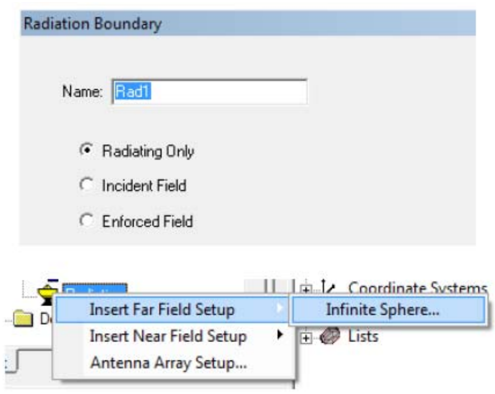

Fig.14. Radiation area definition

We will set the parameters of the far radiation field in this manner (figure no. 15):

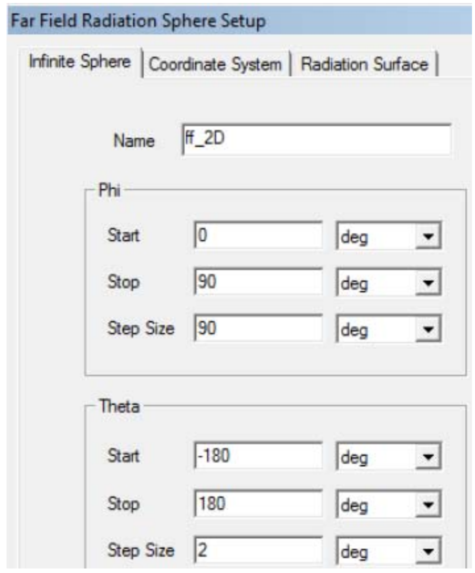

Fig.15. Far radiatin field setup

In the first case we will set the transmission frequency of the GSM dipole antenna to the value of 835 MHz. In the same manner we will proceed to perform measurements at frequencies of 880 MHz and 915 MHz.

We are interested in the SAR evolution across the network of sensors previously defined (see figure no.12). To observe this evolution we create a Field Report that will calculate and show the local SAR value, as well as the average SAR value over the network of sensors (figure no. 16).

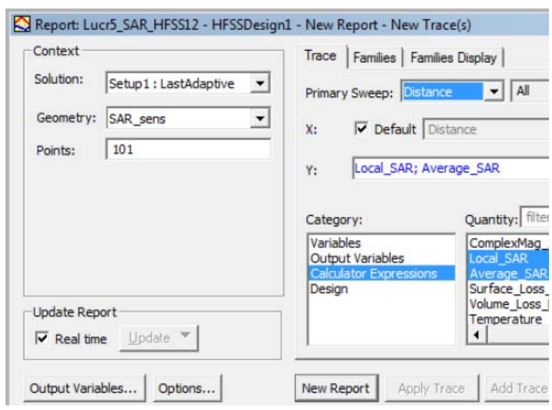

Fig.16. Creating the SAR field report

The SAR report when using the GSM frequency of 835 MHz can be seen in figure no. 17.

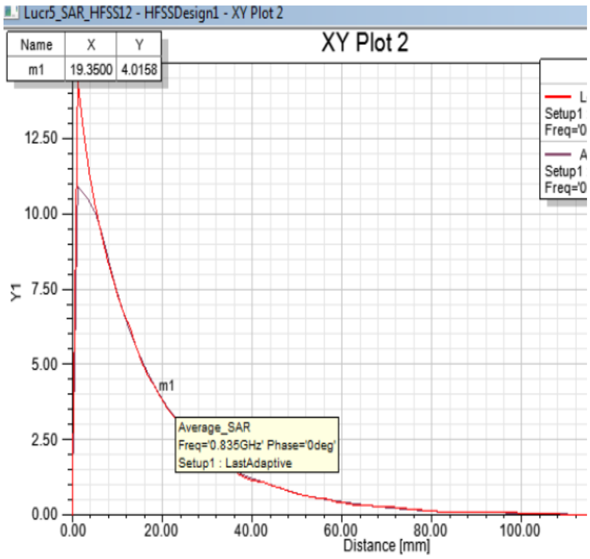

Fig.17. SAR report for 835 MHz frequency

The SAR report when using the GSM emission frequency of 880 MHz can be seen in figure no. 18.

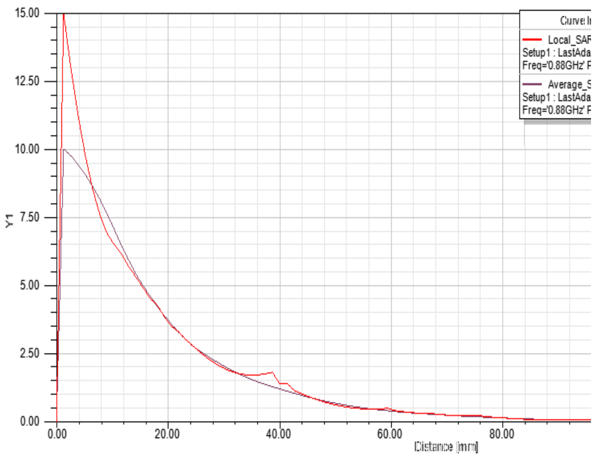

Fig.18. SAR report for 880 MHz frequency

The SAR report when using the GSM emission frequency of 915 MHz can be observed in figure no. 19.

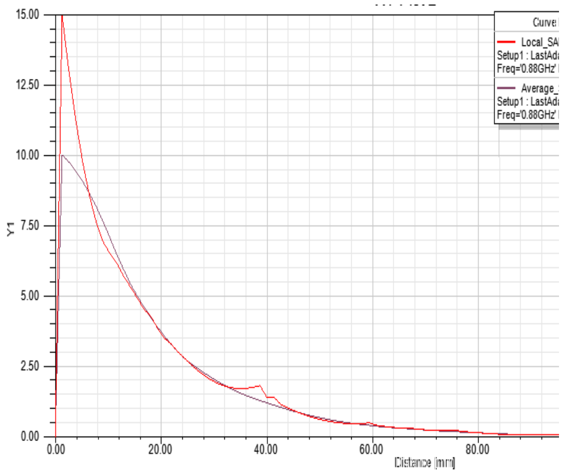

Fig.19. SAR report for 915 MHz frequency

4.CONCLUSIONS & RESULTS INTERPRETATION

The SAR (Specific Absorption Rate) is represented on the ordinate and it indicates the amount of energy (measured in W / kg) absorbed by the human tissues (the head in our case). The distance between the phone antenna and the head is represented on the abscissa (the distance is measured along the sensor network). According to the P1528-2002 IEEE standard at a distance of 2 cm from the antenna (feed point) the amount of SAR must not exceed 4 W / Kg.

The value obtained in the first simulation (when using the 835 MHz frequency) is slightly higher on the graphic i.e. 4.0158 W / Kg. In the second simulation (realized at 880 MHz), as in the third simulation (915 MHz) the average SAR value at a distance of 2 cm from the head is lower than 4 W / Kg: i.e. 3.7217 W / Kg in the second simulation and 3.7109 W / Kg in the last simulation.

Very few mobile phones today still use dipole antennas so the value obtained in these three simulations should not scare us. And more importantly, the modern phones use absorbing systems interposed between the antenna and ear that decrease the SAR values to 0.3 ÷0.8 W / Kg.

Another reason not to worry is that the GSM900 band uses transmission frequencies between 880 MHz and 915 MHz. The 835 MHz frequency used in the first simulation belongs to GSM 850 band which is used in a very small percent around the world.

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NATIONAL UNIVERSITY OF PUBLIC SERVICE

1956 AND THE ART OF WAR

Author: Cadet **Gaspar Palagyi**

Faculty of Military Sciences and Officer Training, University of Public Service, Budapest, Hungary

Abstract: *During the revolution in Hungary in the fall of 1956 the opposing sides faced each other in the urban environment utilising completely different methods. The Soviets relied on their different experiences from World War II and the recent events in East-Berlin, deploying vast numbers of tanks. The insurgents relied mainly on guerrilla warfare in the defense of Budapest. However, as they began to witness the strengths and weaknesses of their different tactics, both sides were forced to eventually alter their respective methods to some degree.*

Keywords: *1956 Hungarian revolution, urban warfare*

1. INTRODUCTION

Any armed conflict or war may be described the most accurately either by determining its character,[1] or by examining the tactics or the different courses of action (COA) taken by the combatants. Looking at the latter in the particular case of the 1956 Hungarian revolt and the following Soviet intervention, we find that the two opposing sides – the authorities and the insurgents, to put it simply – have utilised vastly different methods of fighting. It would seem to be a straightforward deduction to believe this is only down to the obvious differences between their aims and inventories. There are, however, some more and rather complex reasons behind their different approaches, too. In my essay, I elaborate to bring forward these diverse considerations behind their tactics, covering both the challenges faced by the Soviet armoured forces in the urban environment and also the – sometimes surprisingly mature – moves of the insurgents.

2. THE SOVIET FORCES

It doesn't require sophisticated military knowledge to understand that city streets are rather far from the ideal battlefield for armoured units. Their maneuverability and visibility are both highly limited by the buildings, while their vulnerability to concealed anti-tank weapons increases dramatically. Urban warfare also means that tanks can rely neither on their main cannons nor on effective artillery and/or air support without the risk of inflicting heavy collateral damage to the surroundings. These factors suggest that deployment of armoured units into a city area is generally inadvisable and should be avoided as much as possible.

However, urban warfare in the Second World War – especially the Battle of Berlin, the latest and largest-scale of such Soviet operations during the conflict – proved that tanks can be effective even in a built-up or ruined environment if and when provided with

[1] While at first glance it might seem to be only a simple matter of semiotics to debate the character of a conflict, I personally believe that determining the proper category by examining certain angles – such as intentions, intensity, limitations, etc. – paints a more detailed portrait of any given armed conflict, or any other historical event, for that matter. In my view – and contrary to the common misbelief – the hostilities in Hungary during the fall of 1956 cannot be classified as a conventional war. The events can rather be described as a combination of a non-conventional and a destabilising conflict, while also showing signs of anomy at certain points during the course of events. As I built my thesis on a typology devised by Attila Ágh, a Hungarian author lesser known to the foreign public, I decided against including that chapter of the original study in this essay and focused only on the tactical aspects of 1956 in the English version.

adequate support from the other branches of the army. Based on this, my hypothesis is the following: Soviet military leaders were able to build on their experiences from World War II – although not necessarily consciously – to a certain degree in the fall of 1956. On the other hand, it should be stressed that before this realization came to them, the Soviets relied on a tactic that was based on a more current, but in the meantime completely antithetical experience. In the following pages, I debate the different considerations and doctrines behind the activities of the Soviet forces in Budapest, 1956.

To understand the Soviet actions during the early days of the crisis, one must look all the way back to the events that took place in East Berlin in 1953. As the spread of demonstrations throughout the country had been increasingly getting out of hand, the East German authorities requested help from the Soviet armed forces stationed within the borders to deal with the situation on July 17. The following deployment of the Soviet tanks had dispersed the crowds of demonstrating East German workers within a mere few hours. It is important to note that the Soviet tanks had achieved this feat without having to resort to using lethal force [2] or having infantry escort, and with no casualties suffered. The fact that their fearsome appearance in itself had been more than enough to frighten away any protestors gave the Soviet military leaders the idea of using their armoured columns in the same role in the future, should the need arise. This misconception was the primary reason behind their decision to send in the armoured forces of the Special Corps[3] in large numbers to patrol the key routes of Budapest without escort on the morning of October 24, 1956. To their greatest surprise, these patrols achieved nothing, and even worse, their losses began to mount unacceptably high.

However, it should be noted that the Soviets had been trying to avoid engaging the Hungarian insurgents in an all-out conflict at the beginning, which also serves an explanation for their initial non-aggressive approach. Also, one must not forget that the Special Corps faced an unknown situation at first, and the lack of reconnaissance was no doubt a setback when deciding on the best COA. The fact that the Military Committee[4] did not possess any reliable intelligence on the insurgent forces and their movements was clearly demonstrated by a disastrous joint operation with the collaborating Hungarian People's Army (HPA) against the Corvin Theatre[5] on October 28. After the obvious failure of the initial presence patrols, the Soviets were forced to alter their methods and find a way to reduce their losses. In order to do so, they had to discard their previous ideas and rely on their earlier experiences instead – the experiences gained during the siege of Berlin in 1945.

It is interesting to note that during the opening phase of that operation – quite similarly to 1956 – the Soviet armoured forces had been suffering heavily at the hands of the German defenders. The reason behind that was that in the – rather one-sided – dash for Berlin speed had been the utmost priority, while force protection had been completely neglected. After a short while, however, to limit their casualties, the Soviets eventually started to adapt a more careful method. Colonel Sebelev, an engineering officer serving with the 2nd Guards Army had described the new process as follows: "[the Germans] were shooting at our tanks from doorways and windows […]. Instead of using the middle of the roadway, [our tanks] advanced on both sidewalks, and

[2] According to a report written by Grechko, the Commander in Chief of the Soviet forces in East Germany, a total of 209 protestors had been killed or wounded during the days of the uprising, mostly due to the volley fires of the East German Volkspolizei units. This death toll would certainly have been higher had the Soviet tanks opened fire at the unarmed crowds.

[3] A Red Army formation, the Special Corps was the official name for the Soviet military units stationed in Hungary after the withdrawal of forces from Austria in 1955.

[4] The Military Committee was the joint council of the Soviet and Hungarian political and military leaders during the early days of the revolution.

[5] The Corvin Theatre – and the neighboring buildings around it – had been a symbolic stronghold of great importance and also a rallying point of the insurgents. Its strategical significance can be easily appreciated when one looks at the casualties inflicted by these groups on the bypassing Soviet columns.

while one was shooting at the left side of the street, the other was doing the same on the other side. [Now] the Germans are fleeing from the windows." (Beevor, 2002: 313-314) This procedure was further refined by placing machine-gunners on the slowly moving tanks to cover the upper stories of buildings that otherwise would have been out of reach for the tanks' main cannons, as they were higher than their maximum angle of elevation. Based on this, it is safe to state that the Red Army did possess a tried-and-tested method and the necessary amount of knowledge to deal with the hardships of urban combat. However, there was still quite some room left for improvement when the Soviets encountered a surprisingly heavy resistance in Budapest. Since the 1956 revolt was by no means a total war, handling the situation proved to be far more difficult for them than expected. There was also a major difference originating from the distinction between the weaponry of the German soldiers and the Hungarian insurgents, as the latter presented a completely new challenge for the attackers. It is a well-known feature of all versions of the Panzerfaust – the most prolific German anti-tank weapon – that they could only be aimed when the user was placed level with, or slightly lower than the desired target. This meant that the Soviet soldiers had to focus their attention mainly on the ground level and the basement windows of the surrounding buildings, as attack was most likely to come from these directions. On the contrary, the Hungarian insurgent groups possessed no such weapons, thus they were forced to make-do with Molotov cocktails[6]. These makeshift petrol bombs were typically thrown from the fourth or fifth-floor windows, so the tanks crews had to turn their attention upwards, as the danger was looming from above this time. To make matters worse for the Red Army, the insurgents didn't have to establish direct visual contact with the targets to throw the Molotov cocktails from the windows, and usually rushed away from the spot immediately after firing, thus making it extremely difficult for the Soviet forces to effectively engage them in combat (Eörsi, 2000: 273-275). In response to this, the Soviet armoured columns tried to avoid the middle of the roadway and used the sidewalks instead, where it was harder to hit them from above. According to memoirs written by the insurgents, the advancing tanks abandoned the idea of covering both sides of the streets, and opted to process in single file instead to minimize the chance of a successful ambush. Luckily for the attackers, the range of the petrol bombs was rather short, giving the Soviet forces an unquestionable advantage and immunity from attacks in the more open areas of the city – such as squares, for example –, where the insurgents usually couldn't get close enough to cause any harm to the tanks.

Looking back at the siege of Berlin, it may seem obvious that simultaneous deployment of the armoured forces and escorting infantry would have meant mutual protection for both branches, but the full potential of this solution was somehow not realized by the Soviet military leaders until the beginning of Operation Whirlwind. Before that, during the days of Operation Wave,[7] the Soviets were keener on using their armoured vehicles to conduct combat patrols on their own. Their idea was to lure the insurgents into attacking the tanks to give away their positions, so the

[6] The term „Molotov cocktail" originates from the Winter War between Finland and the Soviet Union, referring to Soviet foreign minister Vyacheslav Molotov. The idea behind the weapon was to spread the flaming gasoline on the armor of the vehicles upon impact, where some of the liquid would eventually find its way inside through the air intakes and other openings, igniting the fuel or exploding the ammunition of the tanks from the inside.

[7] Starting on October 24, Operation Wave was the code-name for the original action plan to secure the city of Budapest should any riot against the reigning order take place. The operation proved to be a failure, as the forces of the Hungarian government and the Red Army accomplished little before the armistice on October 28. Contrary to this, Operation Whirlwind was the code-name for the second – and far more successful – Soviet intervention, starting on November 4. Its main goals were to disarm and disband the HPA, to force the insurgents to surrender, and to regain control over the country.

Soviet artillery spotters would be able to direct fire at them from a far. This method required the tanks to speed through the dangerous areas – road junctions, for example – as quickly as possible to minimize their chances of suffering a critical hit, but casualties still remained heavy. What the Soviet leaders did not realize at the time was that the hit-and-run nature of the insurgents' tactics meant that any attempt of a retaliatory strike was rather pointless and only caused needless collateral damage in the buildings. There had been, however, at least one precedent of a different attacking philosophy from the Soviets. In accordance with the established customs within the Red Army and the methods developed during the closing stages of World War II, a Soviet armoured sub-unit launched an attack on the Kilián Barracks utilising a tank desant. Even though they failed at the attempt – not least because the infantry soldiers serving as the desant were mostly unskilled and rather unwilling Hungarian artillery cadets –, it indicates that the Soviets might have been capable of getting the situation under control sooner, had they not faced any restrictions. Apart from the particular attack discussed above, I have come across no direct reference of deploying a tank desant in 1956. However, as it was a common routine in the Red Army, and photo evidence suggests that the infantry personnel of the HPA had also been introduced to this method during basic training,[8] I personally find it quite probable that there might have been other occurrences during the conflict.

Based on my studies, I believe that the initial failure of the authorities can only partly be owed to their unfortunate choice of tactics. The numerical relation of the different army branches is also noteworthy, as there can be no doubt that even though some of the vehicles were clearly unsuitable for urban combat[9] – regardless of which tactic they opted to follow –, Soviet military leaders stubbornly insisted on the dominance of the armoured forces over everything else. Their failure to realize that the routine of an East Berlin-style mass deployment of tanks could not be refined into a winning strategy – not even with the lessons of the Second World War – undoubtedly contributed to the high death toll. It is to their credit, however, that after the futile struggles of October, the commanders of the Special Corps were able to revise their previous ideas for Operation Whirlwind. The combined deployment of the different army branches is clearly evident if one takes a look at the list of the sub-units ordered to strengthen the Special Corps in early November.[10] While the capability of the artillery units to inflict heavy collateral damage had been the very reason to refrain from their deployment earlier, their importance without doubt began to rise after October, easing the former hegemony of the armoured forces. The same could be said about the deployment of reconnaissance troops. The devastating effect of using artillery strikes on the insurgents' strongholds from close distances prior to the actual attack of the tanks and infantry was quite the same as it had been in Berlin eleven years earlier. Although the deployment of heavy artillery units and incendiary rounds proved highly successful in softening up the insurgents' resistance, it should be stressed that this could only be achieved via the ruination of the inner city of Budapest, which the Soviets had tried to avoid as much as possible before.

After all these factors considered, we can summarize that there can be three different phases indentified during the 1956 conflict. The deployment of the Special Corps gradually changed from the early presence patrols to the somewhat more imaginative combat patrols during the last week of October, and from that, into a well-organized,

[8] See the photos from the Museum of Military History in the appendix of Bástya, a book written by Imre Okváth. There are two pieces of archive photos where the Hungarian tank desants are clearly visible.

[9] This is especially true for the BTR-152 APCs, dubbed as the "Open Coffin" by the insurgents. As these vehicles were completely defenseless and open from above, their crews had been extremely vulnerable even to small arms fire or hand grenades (Horváth, 2003: 105).

[10] There were only two armoured regiments among the reinforcements, alongside two airborne desant regiments, two infantry regiments, two heavy mortar groups and a multiple rocket launcher brigade (Malasenko, 2001: 262).

interservice combat operation, which finally brought them the unquestionable edge over the increasingly outnumbered insurgents.

3. THE INSURGENTS

As demonstrated above, the Special Corps had tried a wide variety of moves before finally being able to claim victory. Due to several reasons, the Hungarian insurgents had incomparably less options as they were trying their best to defend against the Soviet – and sometimes the government – forces. In this chapter, I'm discussing the limitations and hardships they were facing, as well as the areas where they had at least a little advantage. The key word here is 'limitations', as their aims, means and opportunities were – in great contrast with their opponents – all severely limited.

Although there were a small number of soldiers and even some officers from the HPA joining the insurgents, the groups were mainly made up of civilians – workers, university students, other youngsters, and even freshly released convicts. This fact had a direct effect on their warfare, as they were forced to make up for their lack of military knowledge and discipline with other values, such as inventiveness or cunning. The same could be said about their weaponry: they had to either make-do with the small arms they were able to procure – which were in most cases outdated, and absolutely of no use against tanks –, or they had to find alternative means to somehow tackle the incoming Soviet armor. On the rare occasions when they did manage to get their hands on more sophisticated equipment, such as cannons or even tanks, the insurgents usually weren't able to extract the full potential of those weapons (Eörsi, 2000: 271 and Horváth, 2003: 426). However, it would be somewhat unfair to say that the insurgents were unfit to handle their arms properly. One must not forget that there had been far more veterans with actual combat experience [11] in 1956 within the Hungarian society than there are today, not to mention those who had received basic military training as part of the so-called Levente movement during the years of the Horthy-era. Also, as there had been a major streamlining effort going on within the HPA since 1953, many previously conscripted soldiers were released from service during the intervening years – it is safe to assume that at least some of them sided with the insurgents once the revolt broke out. All these experiences were no doubt of great value to the armed groups, although it must also be noted that the different Soviet-made small arms of the 1940s and 1950s did not require long time to master anyhow. Another interesting fact about the insurgents is that the younger ones grew up feeding on propaganda movies about the mythical heroism of the Soviet partisans. This had certainly encouraged them to take a similar approach and improvise whenever possible in combat.

Nevertheless, the chances of the insurgent groups for victory had been extremely slim from the beginning, as they had been vastly outnumbered and outgunned by the Soviet forces from the first moment on. It was clearly evident even back then that they could only keep on fighting until the authorities launched an all-out attack against them. This meant that their only possible aim was to stall the invaders long enough to reach some kind of a favorable political treaty. Considering this, it is no surprise that their only chance lied in taking up a defensive method of fighting. As mentioned before, their small numbers permitted control only over the main roads and junctions of Budapest, not the entire city. However, they had at least the advantage of knowing the place better than their opponents, especially as the commanders of the Special Corps had failed to obtain proper intelligence data on the locations and numbers of the insurgents. This factor proved to be crucial in the forthcoming battles. As the course of the Soviet forces were usually predictable, the insurgents were able to damage the surface of many roads in a similar fashion to slow down the incoming armoured columns or sometimes

[11] One such example was 'Uncle Szabó', a World War I veteran, and one of the most famous group leaders (Eörsi, 2000: 281).

even to force them to alter their paths and lead them into ambushes. While on the subject of insurgent actions, mention should be made of a rather unique case. After the second Soviet intervention on November 4, most of the Hungarian militia was forced to fall back into the mountains around Buda. One of these groups somehow managed to acquire an armoured luxury car – it was rumored to be the personal transport of Mátyás Rákosi, the former first secretary of the Hungarian Workers' Party – and used it effectively to obtain intelligence on the movements of the invading Soviet forces. As its appearance was deceiving, and its armor gave it a certain degree of protection, it was ideal for such missions. Unfortunately, the militiamen could not resist the temptation to open fire on the unsuspecting Soviet troops, and the vehicle and its crew was lost during their third outing (Király, 1989: 287-289).

As we can see, the insurgents showed a surprising amount of resourcefulness along their battles. All the examples mentioned above indicate that their hit-and-run tactic to hide in the nearby buildings and wait for the right moment to attack could indeed cause serious damage to the Red Army forces, especially during the last week of October, when they could exploit on the unfortunate Soviet tactics. Later on, after the beginning of Operation Whirlwind, most of the insurgent groups were forced to abandon their stationary method and flee from their former strongholds in order to avoid being captured or completely routed. After losing their key buildings to Soviet artillery fire, most of the militiamen did not establish a new pocket of resistance; instead, they changed their tactics and relied on quick movement and surprise attacks (Malasenko, 2001: 271). Based upon this, we can state that there has been a certain level of changes in the areas of tactics, means and mobility of the insurgents, even if these changes were not as drastic as in the case of the Special Corps.

Another interesting factor that deserves to be mentioned is the attitude of the non-combatant civilians towards the fighters. Although at least some of the civilians were requesting the insurgents to give up fighting and bring the chaotic conditions to an end, most of the people were supportive towards them during the first week of the events. As with the tactics, the turning point can be pinpointed to the second wave of the Soviet attack on the city. One of the insurgent leaders stated that later in his testimony that the formerly helpful and friendly civilian women had started to beg him and his fighters on the third day of Operation Whirlwind to surrender to stop the sufferings of the citizens. It is a well-known fact that all guerrilla groups are heavily dependent on the support of the local population; therefore this might have been another reason for the insurgents to lay down their arms beside the overwhelming Soviet dominance.

4. CONCLUSION

I have discussed the tactical specialties of 1956 in my essay. Although its significance is not as obvious as those of the other local wars in the 1950s – like the conflicts in Korea or Algeria – the Soviet intervention in Hungary was probably the first one on the long list of such actions to come later on. The conflicts in Czechoslovakia and Afghanistan – or the ones in Chechnya, South Ossetia, and other, even more recent events – bear a distinct resemblance to the way the Soviet Union had handled the Hungarian revolution.

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MAGNETIC SYSTEM CONFIGURATION FOR A HALL EFFECT THRUSTER

George – Cristian POTRIVITU

Faculty of Mechatronics and Armament Integrated Systems, Military Technical Academy, Bucharest, Romania

Abstract: *In order to produce the transverse magnetic field needed for the operational process of a Hall Effect thruster, a magnetic system has to be designed. The magnetic system is a key component in a Hall thruster that succeeds to trap the electrons emitted by the external cathode, reducing their transverse mobility in the ionization region so that the propellant neutrals can be ionized. In the same time, the crossed field configuration imparts an azimuthal motion to the electrons (the drift velocity) which forms the Hall current ("electrons cloud"). The present paper presents the magnetic system configuration for HET – 1000, a new Hall thruster designed during a research project conducted at ALTA S.p.A. laboratories, in Pisa, Italy. The paper presents the main aspects of the magnetic field simulations using FEMM and the main results of the different approaches.*

Keywords: *Hall Effect thruster, magnetic field, plasma, magnetic saturation, magnetic coils, magnetic screens.*

1. INTRODUCTION. HALL EFFECT THRUSTERS

1.1 General overview and the thruster geometry. A Hall Effect Thruster also called Stationary Plasma Thruster (SPT), Closed Electron Drift Thruster (CEDT) or Magnetic – Layer Thruster (MLT) is an advanced electric propulsion device with relatively simple design geometry but with very complicated and still not very well known working physics processes than an ion thruster. The HETs produce a lower specific impulse but the thrust – to – power ratio it higher, which means that the thruster will need a lower power level in order to operate properly (Goebel and Katz, 2008). Unfortunately the lifetime is shorter than an ion thruster (currently developed HET can operate up to 10000 – 15000 hours) but despite this fact, the total impulse capability can be compared with the one in ion thrusters (Goebel and Katz, 2008)..

A HET usually consists of four important systems, or parts: a discharge channel (annular or cylindrical), the anode – which also serves as propellant injector (distributor) in the majority of the existing configurations of HET (placed upstream the channel exit plane and responsible for producing the electrical field together with a cathode), a magnetic system (which produces a radial magnetic field perpendicular on the electric one; usually consists of one (internal) coil, with a core made of materials with high magnetic permeability, poles and magnetic screens all connected together through a support plate; it can also have additional external coils) and a cathode external to the channel or aligned with the thruster centre line and placed inside the thruster.

1.2 Plasma formation mechanism. The mechanism of plasma formation inside the discharge channel of a HET can be explained relatively easily. As it can be seen in Figure 1.1, transverse – radial magnetic field is established with a specific topology of the magnetic lines, and with a maximum strength in the vicinity of the exit plane of the channel. In the same time an axial electric field is created between the anode (positioned back into the channel) and the plasma formed by means of the external hollow cathode.

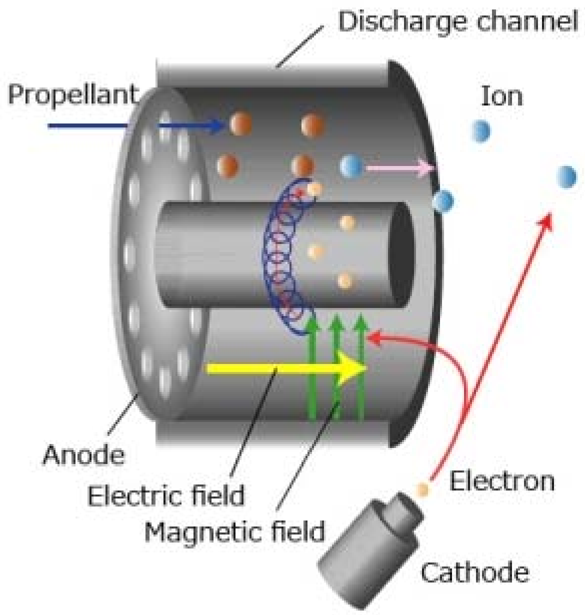

Figure 1.1 HET with insulating walls cross section schematic

The cathode emits electrons which tend to reach the positively charged anode. On their way to the anode, the electrons are trapped into the radial magnetic field. For the electrons to remain trapped and spiral the magnetic field lines (in other words for the electrons to remain magnetized and their mobility to the anode to be reduced), the strength of the magnetic field has to be strong enough so that the Larmor radius, r_e, of the electrons should be much smaller than the channel length, L (Goebel and Katz, 2008).:

$$r_e = \frac{v_{th}}{\omega_c} = \frac{m}{eB}\sqrt{\frac{8kT_e}{\pi m}} = \frac{1}{B}\sqrt{\frac{8m}{\pi e}T_{ev}} \ll L, \quad (1.1)$$

where v_{th} is the thermal velocity, k is Boltzmann constant, m is the mass of the elementary particle, ω_c is the cyclotron frequency and T_{ev} is the electron temperature in eV.

In the same time, the electrons should remain magnetized if the electron Hall parameter is bigger than the unit (where ν is the collision frequency) (Goebel and Katz, 2008):

$$\Omega_e^2 = \frac{\omega_c^2}{\nu^2} \gg 1 \quad (1.2)$$

In the region corresponding to the maximum of the magnetic field strength the electrons have a reduce mobility and a high temperature (experiencing Joule heating). This explains the peak of the electric field in the same region as the magnetic field. Upstream the electric field maximum it can be defined the “ionization region” where almost all the neutrals have to be ionized before reaching the exit plane. This region is characterized by a specific length called “plasma length” over which the plasma is magnetized.

In the crossed field region an azimuthal drift is imparted to the electrons and their movement produces a high induced current, the Hall current. The neutrals propellant particles, which are injected from the backside of the anode, pass through the closed drift electrons cloud and after the ionization events the neutrals will be ionized and other electrons will be released during the process. The reduced axial electron mobility permits the applied discharged to be aligned with the channel axis in the quasi – neutral plasma, and the resulted axial electric field in the channel accelerates the ions downstream the exit plane and form the beam. The ions trajectories do not have to be influenced by the magnetic field, so the latter has to be weak enough not to interfere with the ions (Goebel and Katz, 2008):

$$r_i = \frac{v_i}{\omega_c} = \frac{M}{eB}\sqrt{\frac{2eV_b}{M}} = \frac{1}{B}\sqrt{\frac{2M}{e}V_b} \gg L \quad (1.3)$$

where r_i is the Larmor ion radius, v_i is the ions velocity, M is the propellant atomic mass and V_b is the beam potential. The beam of ions is neutralized by some of the electrons emitted by the cathode. An advantage given by this plasma producing mechanism is that the acceleration of the ions occurs in the plasma region (ionization region), namely inside the channel, so the space charge is not an issue (Goebel and Katz, 2008).

2. MAGNETIC SYSTEM CONFIGURATION

2.1 Classical configuration and magnetic field topology. Back to the m agnetic system configuration, in Figure 2.1 a Ha ll thruster magnetic s ystem class ical config uration is presented. To produce a m agnetic field with a certain strength two possibilities can be used: electromagnetic coils and perm anent magnets. Both have advantages and disadvantages. Firstly, using a system based only on permanent magnets certain strength of the field can be obtained without the possibility to change it during differe nt operational m odes. In the same time, using permanent magnets the field cannot be shut down during thruster start – up, when the electron density is low and with a strong field the initiation of the ionization cascade p rocess is d ifficult to be established (Warner, 2007). Both th ose two disadvantages are overco me by the electrom agnetic co ils, which unfortunately have increased ohm ic heat dissipation which adds to the thruster operational heat dissipation during the ionization process. The high tem peratures are an im portant problem both for perm anent magnets and for the electromagnetic coils.

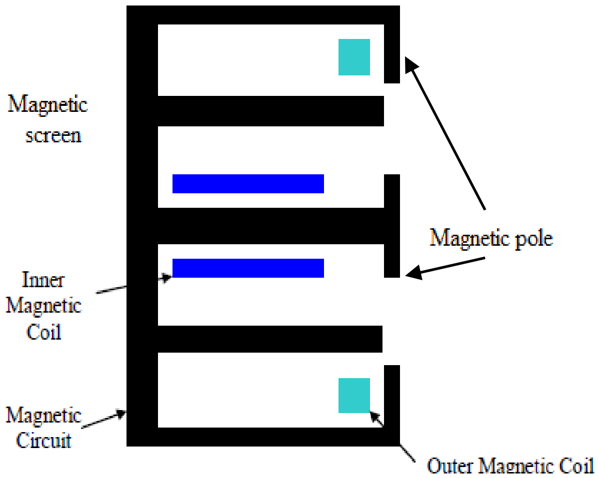

Figure 2.1 Hall thruster magnetic system classical configuration.

Permanent m agnets usually experience a reversible loss of field strength with increasing temperature, and in the case of electromagnetic co ils, with the increa sing temperature due to high er currents, the circuit core material, typically iron based alloys, lose permeability as the saturation point is reached. Moreover, the usage of perm anent m agnets (which usually chip easily) imply a capsulation method for those, otherwise a channel contamination with s mall magnetic debris can occur leadin g to electrical shorts between the anode and low potential surfaces (Warner, 2007).

Once integrated aboard a spacecraft the HET produces the ion beam composed of ions which have a sm all azim uthal velocity. This drift induces a sm all to rque on the spacecraft that can be balanced by the m omentum wheels (Warner, 2007). The electrom agnetic coils can reverse the field direction to induce a torque in the opposite direction and rem ove the angular momentum im parted to the spacecraft. Permanent m agnets cannot reverse their field direction once placed insi de the thr uster. The high tem perature reached by the electromagnetic coils during operation can electrically short the m agnetic wire insula tion. However the tuning possibility of the magnetic field and th e possibility of shutting down the magnetic field, as well as the ion angular momentum balance by m eans of the field reverse are advantages that m ake the electromagnetic co ils th e preferred choice for the m agnetic system s of a Hall thruster. Th e electromagnetic co ils are, in fact, the core of this system (Denning and Riedel, 2008). Unfortunately not only the strength of the magnetic f ield is im portant, but also the magnetic field lines topo logy. In order to slow the electrons in the v icinity of the channel exit and to prevent high back – stream ing currents, the lin es inside the c hannel sho uld be as parallel as possible to the anode face. The symmetry o f the field lines ins ide the channe l prevents also the unequal erosion process of the channel walls.

In order to create this topology focusing magnetic poles are used on top of the inner and outer magnetic components. In the same time magnetic screens may be used to uniformly direct the magnetic lines and to create the topology (Denning and Riedel, 2008). All those elements are connected together using a support plate and cores which forms a magnetic circuit and which are made of magnetic materials with high magnetic permeability.

2.2 HET – 1000 magnetic system configuration.

The maximum magnetic field strength needed for a nominal operation ($P_d = 1000$ W, $V_d = 300$ V) for the proposed thruster, HET – 1000, is around $B = 196$ G (0.0196 T). Hence, the magnetic system has to be designed to reach a magnetic field strength of around 0.02 T in the vicinity of the channel exit plane. In the same time the magnetic field strength should have a variation inside the discharge channel described at best by the following equation (Know, 2010):

$$B(z) = B_{max} \exp\left[-K\left(\frac{z}{L}-1\right)^2\right], \qquad (2.1)$$

where K is the shape coefficient and $z = 0 \div L$. Figure 2.2 presents the variation of magnetic field distribution inside the discharge channel as a function of K. An ideal distribution is found when K is 16. As K decreases, the magnetic strength at the anode tip increases. A large magnitude of the magnetic field near the anode region causes a significant performance loss because the ionization process can start immediately after the neutrals are injected through the anode tip and so a relatively large amount of ions can return to neutrals after the recombination process at the side dielectric walls (Know, 2010). To satisfy these two conditions, Maslenikov theory was used in designing the magnetic system (Know, 2010; Maslenikov, 1991).

The magnetic field simulations were conducted using FEMM 4.2 – Finite Element Method Magnetics, an analysis tool that performs finite element analysis on permanent magnets as well as electromagnets. FEMM 4.2 works under the assumption that the field is time – invariant and the magnetic material is linear isotropic; it then applies these assumptions to Maxwell’s equations to model the magnetic field.

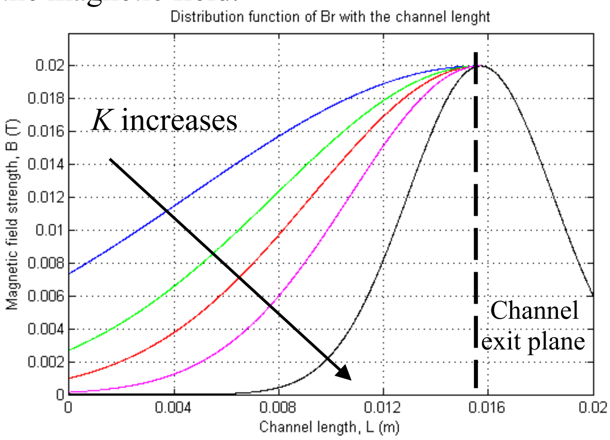

Figure 2.1 Variation of the magnetic field inside the discharge channel for different shape coefficients, *K*.

The initial design proposed a very simple magnetic system . To produce the magnetic field electromagnetic coils were considered to suit best the proposed model as they offer important advantages over permanent magnets. Regarding the fact that the computed dimensions of the discharge channel for HET – 1000 are small, at the beginning a single central coil was considered. The coil was formed of 78 turns of 1.6 MM copper wire (Metric Magnet Wire system) (*Magnet wire dimension chart*, Allem, Inc.), with a total diameter (including insulation) of 1.95 mm. The central and the outer components have both poles and are connected through a base plate. HET – 1000 presents symmetry of the magnetic system which allowed computing axisymmetric analysis in FEMM 4.2. As environment air was used instead of vacuum because FEMM 4.2 does not have implemented vacuum in its materials library. For the core material Hiperco – 50 was chosen.

In order to satisfy the condition for the magnetic field line topology, a second coil was added to the model. The external coil is placed around the external screen of the system . This coil will decrease the needed current in the central coil and the magnetic field topology is now uniform, centred inside the channel and the lines are parallel to the anode tip. The core material chosen for the final design was

Hiperco – 50 (Warner, 2007) and the environmental material in the simulation was air.

Above it was presented that the magnetic circuit material should be Hiperco – 50, hence, a discussion on soft magnetic core materials is useful. A soft magnetic material is a ferromagnetic material which can be easily magnetized but do not tend to stay magnetized. Whilst inside the coils a current passes, they produce a magnetic field which magnetizes also the magnetic circuit soft magnetic material and when the current stops, the magnetic circuit material is no longer magnetized. Those cycles of magnetization and demagnetization are always defined by a hysteresis loop (which is usually smaller than in the case of hard magnetic materials – magnetic materials which once magnetized tend to remain magnetized), and after the demagnetization process the properties of the core material changes.

Another important aspect is the saturation point for the core material. This point is reached when an increase in applied magnetic field *H* cannot increase the magnetization of the material further so the total magnetic flux density, *B,* levels off. Each material has its own saturation point. Knowing this point is crucial because, as the studies shown, the saturation point decreases with an increase in the temperature (Warner, 2007). As the permeability of the material is directly proportional to the magnetic flux density and inversely proportional to the applied magnetic field ($\mu_r = B/H$), it has a maximum when the saturation point is reached and then declines if the applied magnetic field continues to increase.

When choosing a material for the magnetic system parts, three important aspects should be taken into consideration: the maximum saturation magnetic field strength, the thermal conductivity and the Curie point. The saturation point, as it was presented above, should be as high as possible. The thermal conductivity should be also high taking into consideration the fact that the magnetic system is an important component of the heat ejection pathway. Lower thermal conductivity means higher temperatures in the pole regions, near the plasma discharge, and a lower point of saturation. The Curie point is the temperature over which the demagnetization process occurs; the molecular movement destroys the alignment of the magnetic domains. Due to the small dimensions of the HET – 1000, the temperatures reached during operation should be high, so a higher Curie point of the core material prevents the inconvenient of demagnetization and saturation. According to the extensive studies on Hiperco – 50 conducted by NASA, this material saturates at 2.1 T when operating at a temperature of around 866 K (Warner, 2007). Moreover, if the temperature increases and reaches values around 1033 K the saturation point declines to 1.8 T (Warner, 2007).

Figure 2.2 presents the plot of the magnetic field strength and topology for half of the thruster. It can be seen that the topology of the magnetic field inside the channel is a proper one, with the lines parallel to the anode tip. This was possible using two coils, an internal and an external one, and two magnetic screens. The plot is in units of tesla and the lower bound and the upper bound were set to 0 T and 0.7 T respectively.

In Figure 2.3 the plot of the magnetic field strength and topology inside the discharge channel of HET – 1000 is presented. Near the anode the strength of the magnetic field reaches a mean value of 0.0025 T, which is a proper value that guarantees a thruster operation without important efficiency loss. During the simulations a compromise had to be done between the lines topology and the strength uniformity as functions of the channel width, *h*. It was preferred a magnetic field line topology as centred and parallel to the anode as possible, instead of a perfectly cantered magnetic strength.

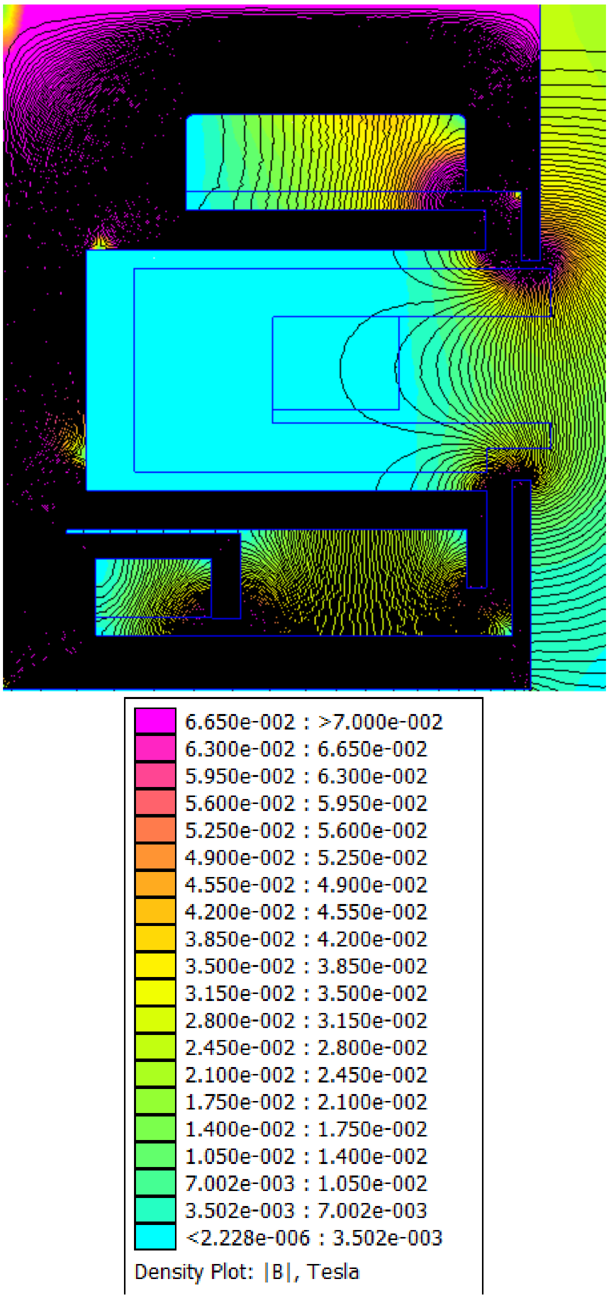

Figure 2.2 Plot of the magnetic field topology and strength within the final magnetic system configuration for HET – 1000 (FEMM 4.2 simulation).

In the case of the anode tip region, the distribution of the magnetic strength with the channel width has slight variations up to 0.0005 T. In Figure 2.4 a better representation of the magnetic field lines topology inside the discharge channel is also presented.

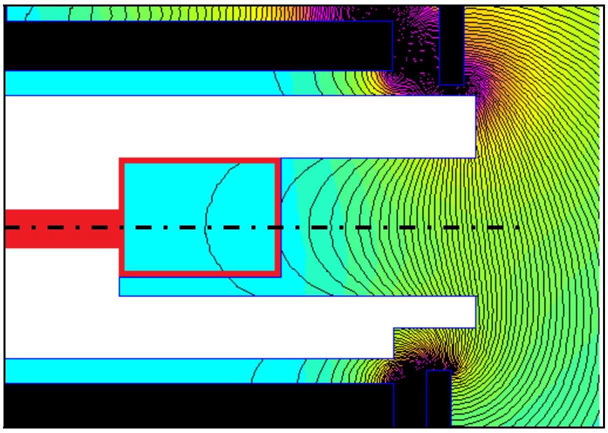

Figure 2.3 Plot of the magnetic field strength and topology inside the discharge channel of HET – 1000 (FEMM 4.2 simulation).

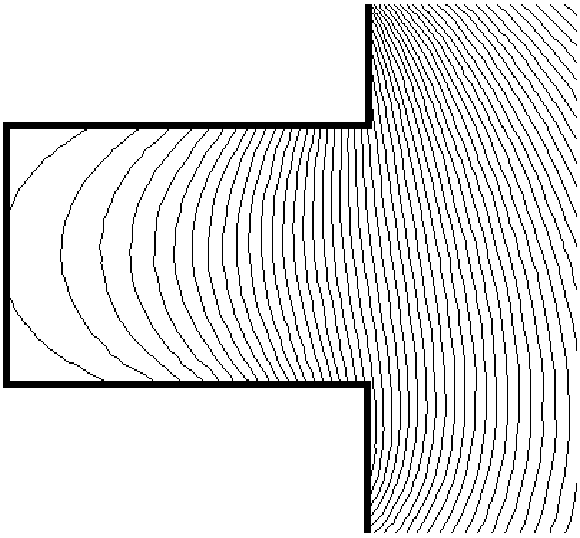

Figure 2.4 Magnetic field lines topology inside the discharge channel of HET – 1000 (FEMM 4.2 simulation).

As it was presented at the beginning of the Chapter, the magnetic field strength distribution can be computed as a function of the distance along the discharge channel using equation (2.1). In this equation the shape coefficient K should be equal to 16 to have a perfect distribution with a 0 T magnetic strength near the anode and a maximum at the exit plane of the thruster. In the case of HET – 1000 the FEMM 4.2 simulations of the magnetic system showed that the magnetic field strength near the anode equals 0.0025 T and the maximum reached at the exit plane is around 0.0198 T. This implies a shape coefficient for the distribution of 2.19.

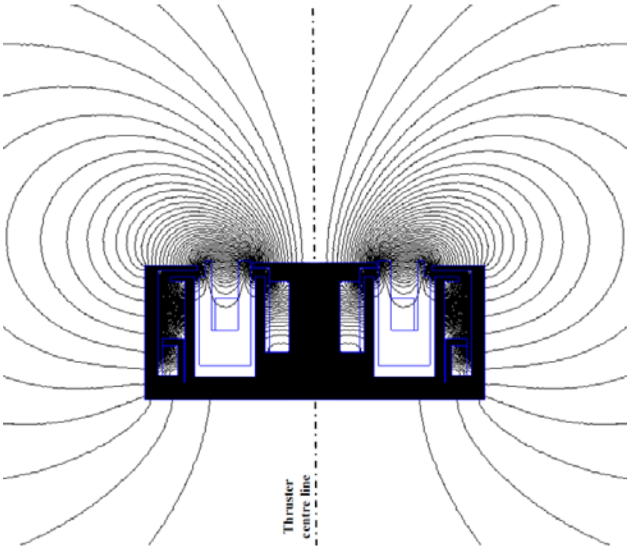

Figure 2.5 Simulated magnetic field topology for HET – 1000.

3. CAD DESIGN OF THE MAGNETIC SYSTEM

In Figure 3.1 it is presented the magnetic system of HET – 1000 formed of: a base plate, the central body with its pole, the central coil around the central body, the outer body with its pole, the screens system (inner and outer screen fixed on a base), and the external coil placed inside a support. All the components are made of Hiperco – 50 except the external coil mount which is made of 1018 steel.
On the base plate all the other elements are fixed using M3, M4 and M5 screws. To assure the alignment and the position accuracy of each attached element, on the base plate are shaped the spaces for the central and the outer bodies and are also drilled the input and output holes for the coils, a hole for the electric input wire which puts the anode under potential and two holes for the propellant inputs to the anode.
The central body is machined from a single piece of Hiperco – 50 and around it is placed the central coil made of 74 turns of *Φ 1.6* mm copper wire insulated with polyimide to a final diameter of *Φ 1.95* mm. The manufacturing process of the coil turns should be done very carefully not to damage the wire insulation when it is curved. On the central body the 2 mm thick pole is fixed using a M5 screw.
The inner and the outer screens are made of curved Hiperco – 50 plates with the extremities welded together. Both of them are then electron beam welded to a plate which is then fixed to the base plate with screws (Hiperco – 50 has a good weldability (Warner, 2007)). The top part of the outer screen is also welded to the screen. Together with the screens system the support of the discharge channel is held in place. This support is made of 1018 steel. On the screens system plate three holes are shaped of 1 mm depth in which the insulation cups for the anode fixing stems are placed.
The outer body is also made of a curved Hiperco – 50 plate with the extremities welded together and, in order to be fixed to the base plate, it is first welded to a support plate. The outer pole is placed on the body and fixed with screws. In the same time the external coil is mounted in the 1018 steel mount, and then fixed to the base plate using the same screws as for the outer body.

4. CONCLUSIONS

The development of the magnetic system IS very important being the core of a new Hall thruster model. After many FEMM magnetic field simulations a final configuration was found implying the use of two coils and a Hiperco – 50 core system formed by two screens, two main magnetic bodies with their focusing poles, all fixed on a base plate.
The final design of the magnetic system proposed for HET – 1000 thruster provides, based on the simulation results, a proper magnetic field with a maximum strength in the vicinity of the discharge channel exit plane and with a low enough strength near the anode tip. Moreover, the topology of the field lines is well defined with parallel lines and parallel with the anode tip and with an axial symmetry regarding the discharge channel. Those aspects

are very important when speaking about the lifetime of the thruster.

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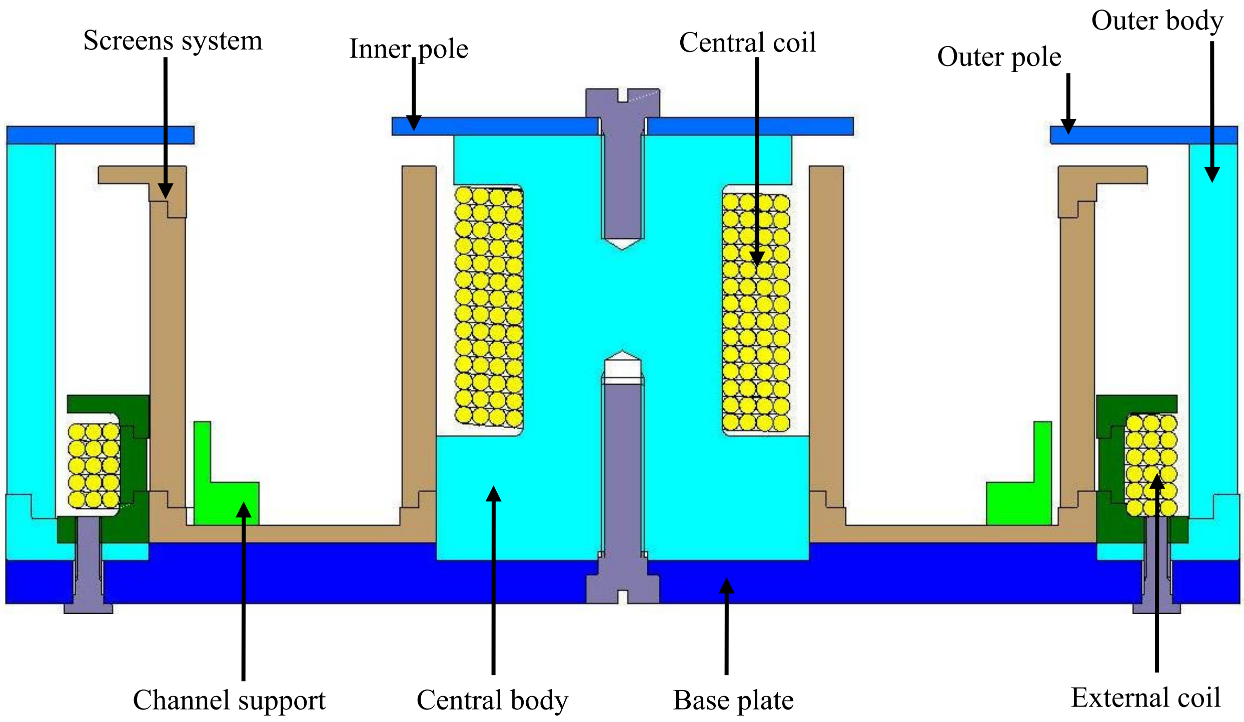


Figure 3.1 Magnetic system configuration of HET – 1000.

MODELLING OF TARGET DETECTION BY ACOUSTIC RADAR AT MATLAB

Filip VÍCH

University of defence,Faculty of Military Technology, Radar department, Czech

Abstrac: *The work deals with the problem of acoustic radar. The first part focuses on basic principles of acoustic radar. It's main parts and used signal processing method – the correlation. This part explains what correlation means and what are the possibilities of outcome. It also explains the basic principle of operation of the acoustic radar.*

The second part is devoted to developing of software/ application for operating the acoustic radar in MATLAB. In basic way it describes the method of programming and used functions of MATLAB. As well, there are examples of the most important parts of the application. Otherwise there is explained the operating of crated software.

The third part of work shows the real laboratory acoustic radar for performing measurements and testing quality of transmitting signal. It explains from which parts the radar is made, than connection of these parts and as well, it shows all of these components. Finally explains the synchronization of transmitting and receiving part.

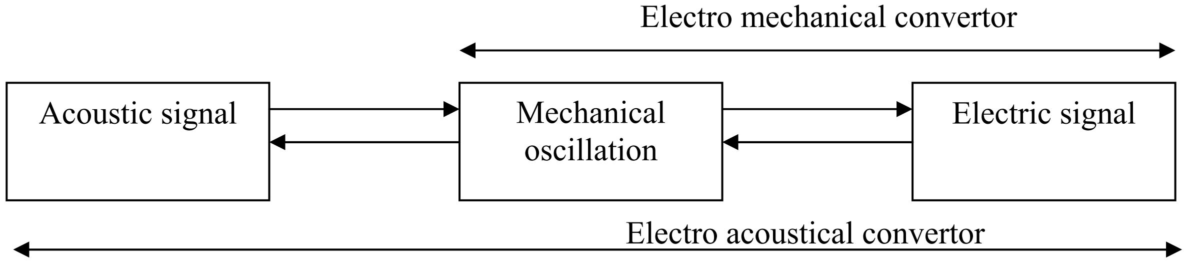
Outcome of this work is theoretical analysis, the acoustic radar made from transmitting and receiving part and functioning application.

1. PRINCIPLE OF ACOUSTIC RADAR

First of all the basic principle of radiolocation is target detection in air space. Active radiolocation is based on principle of transmitting electromagnetic energy and receiving the rebounded echo of target.

In this case of acoustic radar, the electromagnetic energy is replaced by the acoustic energy. Of course, the range of this radar is shorter because of physical reasons. The basic block diagram of acoustic radar is in the chapter 4.

Physically acoustics is described like the propagation of sound. The sound is made by mechanical vibration of flexible material environment. Acoustic wave is defied like compressing and thinning of environmental particles, which are diffusing in all directions and in this case the acoustic pressure is made. This pressure is made by electro acoustical convertors whose operation is described in the picture below.



Pic. 1.1. Electro acoustical convertor.

These convertors are realized by a speakers and a microphones.

The calculation of speed of diffusing is important for acoustic wave, because this speed is different in different climatic conditions. The calculation of speed is basically described by equation below.

$$v = 331{,}57 + 0{,}607.\Theta\ [m.s^{-1}], \tag{1.1}$$

where v is speed of sound,
Θ temperature of oxygen [°C].

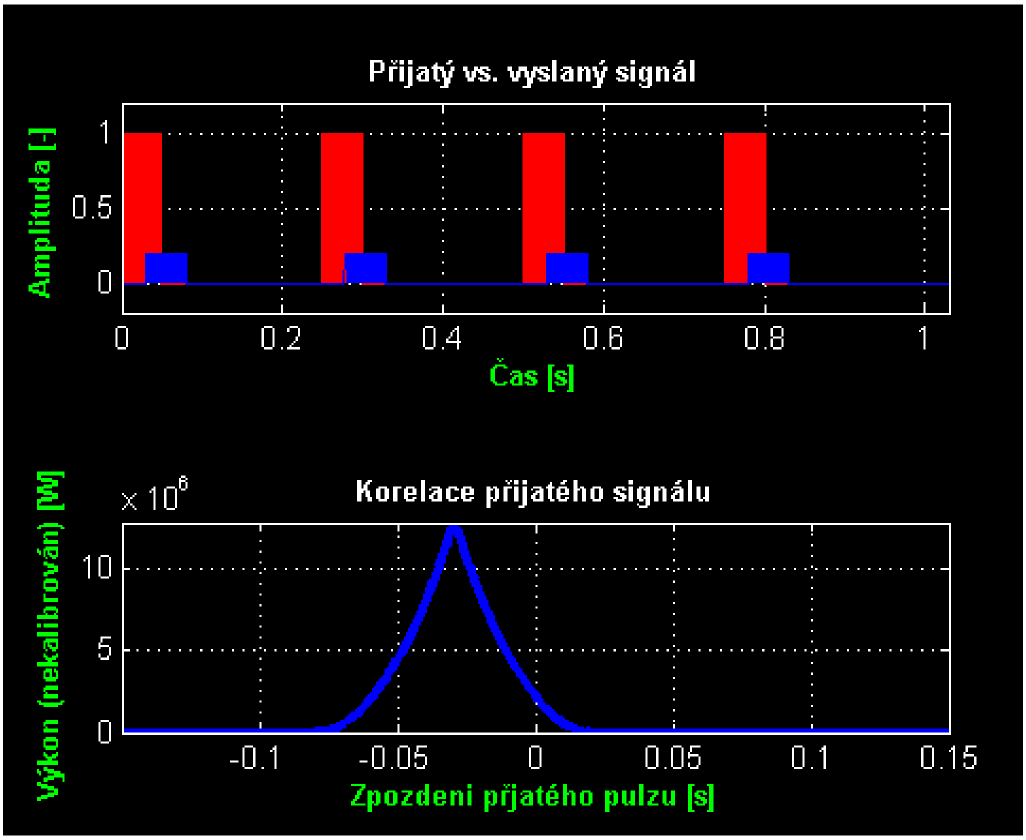
Correlation

Correlation is a sequence of certain operations, which can, in the most general case, express any data sequence similarity. In this case – the radiolocation, we are talking about sequence of radar data making a specific signal. This is a procedure where a degree of similarity of those signals is detected. This similarity can be assessed in continuous and as well in discrete signals.

Example of using the correlation in MATLAB

As a finally part of correlation is their using in MATLAB. In the picture below, there is shown, how the correlation look like.

At the upper diagram, there are two signals, the red one (transmitted) and the blue one (received). At bottom diagram, there is result of calculating the correlation of these square pulses. Also there we can see the difference between transmitting and receiving.



Pic. 1.2 Correlation in MATLAB.

2. APPLICATION IN MATLAB

Switched board programming

This programming method is using orders *switch* and *Case*, which are most important for this application. Next parts of application are objects made by *Handle graphics*. In general, the programming of any application in MATLAB by *Switched Board Programming* is very similar to Borland Delphi environment.

Basic parts of application

Function – *Function*

Basic parts of application

Function – *Function*

Thanks to this function we are allowed in one m-file usin g a lot of variab les, which are defined only inside of this function and the result is tha t ne ither of them is inf luenced of each oth er with the sam e nam e in different applications. The example of function is below.

```
function BP(in_var),
end;.
```

Function – *Switch – Case*

It is m andatory to use both of these functions together. Firstly for branching the program wickedly at variab les. The example of function is below.

```
switch(in_var)
        case('end')
      delete(get(0,'children'))% deleting of
all data
```

Graphic objcts Handle Graphics

Handle Graphics is system , which is implemented in MATLAB, thanks this the user can work with graphic objects.

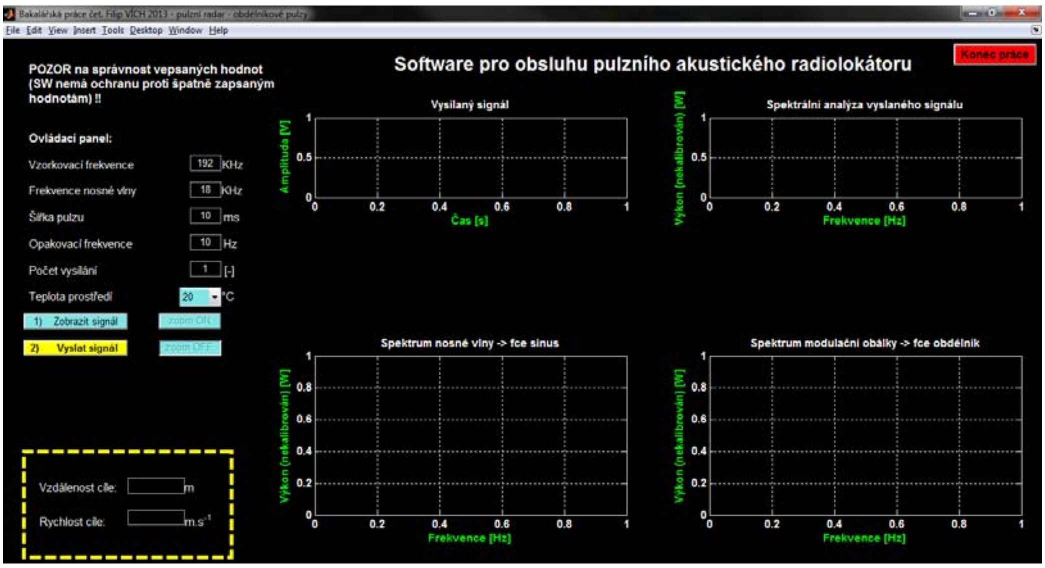
1. APPLICATION FOR USING THE ACOUSTIC RADAR

Description of the function of the application

The applica tion is m aking data signal with carrier wave frequency defined by user. This signal is send by sound card into the spe aker or line-out connector. By internal or exte rnal speaker is generated the acoustic wave into the air sp ace. Returned echo is received by microphone through the acoustic card and saved to the com puter. In application are by correlation these trans mitted and receiv ed signals evaluated a nd the result is representation of distance and speed of target.

Descriptions of the functions and commanding the application

After initia lization of applica tion we are shown the m ain window with pre-defined signal data and objects.



Pic. 3.1 Main window of application.

The main parts for user are in the middle of left side of the application. The first line is sampling frequency, than frequency of carrier wave, pulse width, pulse repetition frequency, number of measuring and temperature of environment.

After click on the 1) button (show the signal) is counted the transmitting signal.

Pic. 3.2 Button show the signal.

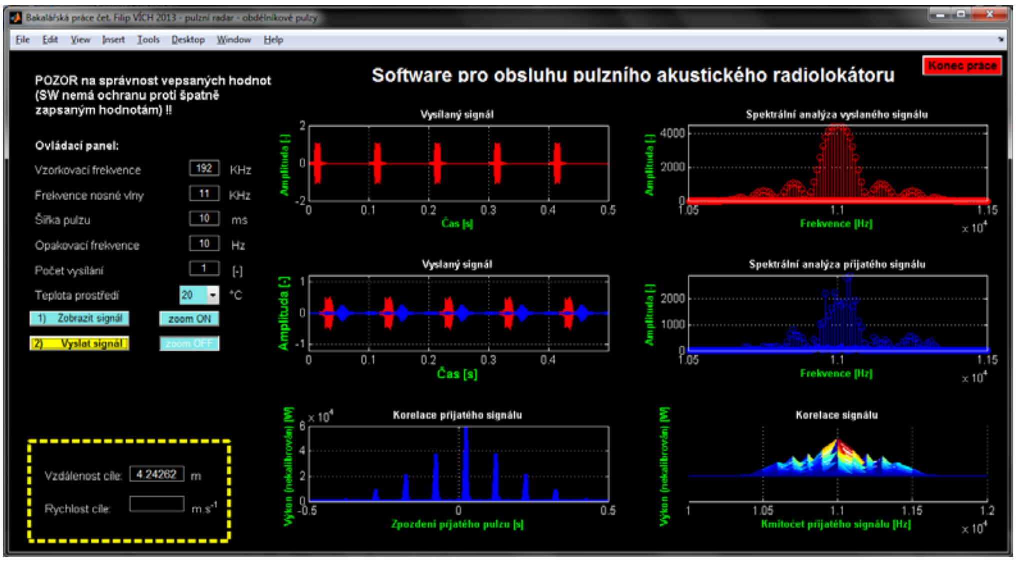
In the next picture is example of pre-defined signal.

Pic. 3.3 Example of pre-defined signal.

When the diagrams are shown, the next step for user is to click at the second button, which is the transmitting button.

Pic. 3.4 Button transmit signal.

After the transmitting and receiving operations these diagrams are shown, which represent the transmitted signal on the top (time and frequency base), the transmitted and received signals in the middle with frequency spectrum of received signal and correlation in the bottom in time and frequency base for calculating the distance and speed of target.

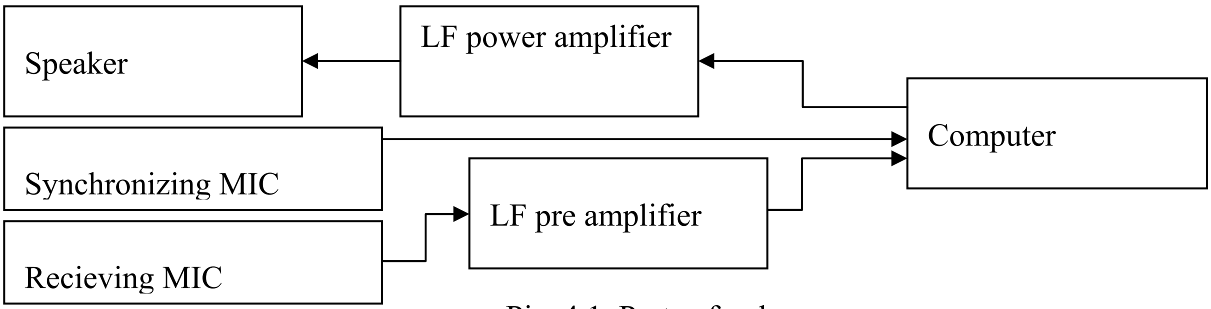


Pic. 3.5 Results of measuring

1. Hardware of the acoustic radar

Connecting of parts of the acoustic radar

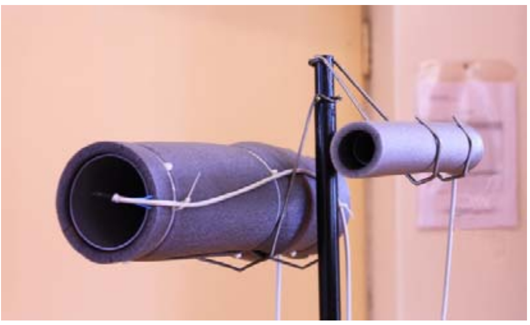
The acoustic radar is in basic way the same, like another electromagnetics radars. It consist of transmitting part (computer, power amplifier, speaker) and receiving part (microphone, pre-amplifier, computer). For synchronizing of RT and TX signals there is the synchronizing microphone for recording the TX signal. The block diagram is shown below.



Pic. 4.1. Parts of radar.

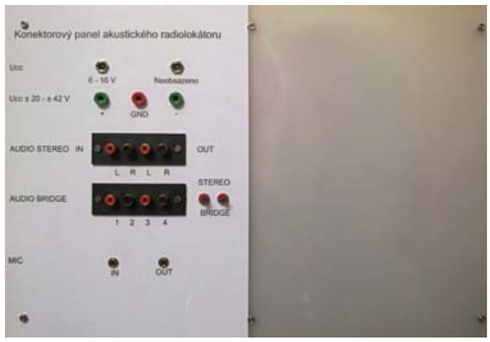
The radar with the components

In this picture is shown the RX and TX parts of the radar.



Pic. 4.1. RX (MIC – the smaller tube) and TX (Speaker – the bigger tube).

In this picture is shown the connectors for both amplifiers for the acoustic radar.



Pic. 4.2. Connector pannel.

ROMANIA
"Henri Coandă" Air Force Academy

160 Mihai Viteazul st. Brasov 500183
Tel +40 268 423421 www.ahafc.ro/afastud/arhiva.html
E-mail: afa_stud@afahc.ro