

# **Institutional Cooperation in Tele-Echography and Erasmus Program: The experience of two institutions in Cyprus and France**

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## **Abstract**

The Cyprus University of Technology (CUT) and the University of Orleans in France cooperate in a research program in Telemedicine and in an educational exchange program under the European program Erasmus. The specific field of the research program is the Tele-echography and there is an on going project with the acronym MARTE (Mobile And Robotised Tele-Echography). The educational program consists mainly of exchanges of students and academic staff.

The main scope of the project MARTE is the development of a tele-echographic system with which a specialist doctor would be able to examine a patient located in a remote place anywhere and under various conditions. The examination would be possible thanks to a video conferencing system and a tele-operated robot, which is controlled by a specialist doctor. This project is a continuation of a European funded research project named OTELO (FP5). MARTE began in 2004 and since then it is financed mainly by the cooperating Universities and the governments of Cyprus and France. In this complex project, in addition to the two Institutions, are involved two hospitals, one in Cyprus and one in France, another Institution (University of Cyprus), the Cyprus Telecommunication Authority, and other private companies in Cyprus and France. The educational exchanges are mainly financed by the Erasmus program and by the two Universities in the two countries.

This paper comments on the experience acquired by the two Institutions CUT and University of Orleans from this international research and educational cooperation

## **Introduction**

The Cyprus University of Technology (CUT) and the University of Orleans in France have developed the last 5 years a fruitful cooperation in research and educational programs. The research program is in the field of Telemedicine and the main project work is directly related to Tele-Echography. The acronym of the on going project is MARTE (Mobile And Robotised Tele-Echography) and at this moment is in the 3rd phase. The educational collaboration of the two institutions is established after the signature of Bilateral Agreement in the framework of the Erasmus program and consists mainly of student and teacher exchanges.

The target of the MARTE project is the construction of a telemedicine system to provide the possibility to a specialist doctor to perform a tele-echography examination to a remote patient using a tele-operated controlled robot. In the frame of this project, different validations have been performed to investigate the technical performances of the tele-operated chain, the quality of the echography and the repercussions on the clinical aspect. An important characteristic of this project is the involvement of many partners from the two countries of the cooperation Institutions, France and Cyprus and the use of high-tech equipment. More details about MARTE will be given in the next paragraphs.

As regards the educational exchanges the students are basically doing there final year projects and/or training in the partner Institution for a duration of usually three months. The teacher exchanges are most of the times of one to two weeks duration and the visiting teachers according to the regulations of Erasmus program are giving lectures directly related with the academic program of the host Institutions.

This paper describes the research and educational cooperation of the two Institutions and comments on the experience acquired from this collaboration.

### **The cooperating Institutions**

The Cyprus University of Technology (CUT) is a new state university established in 2004 in Limassol, Cyprus. CUT has absorbed the Higher Technical Institute which was in fact the institution which began the cooperation with the University of Orleans. The cooperation started initially with research collaboration under the project MARTE and later was established an agreement for an educational collaboration under the European program Erasmus. The departments involved in this cooperation are the Electrical Engineering and Information Technology Department of CUT with its Telemedicine Laboratory and the PRISME Institute (ex Laboratory of Vision and Robotics (LVR) of the University of Orleans). This new research institute PRISME comprises some 170 university researchers, engineers, technicians and doctoral students at several locations: Bourges, Orleans, Chartres, Chateauroux, and Paris. The PRISME Institute conducts multidisciplinary research covering a wide spectrum within the general domain of engineering sciences: combustion in engines, energetic, aerodynamics, mechanics of materials, image and signal processing, control theory and robotics. The institute is jointly administrated by the Bourges Higher National School of Engineering and the University of Orleans.

Certain members of the research team of the CUT have participated previously in the OTELO project and they have a long experience in tele-echography. Other members have participated in many European programs acquiring a good experience in the management of projects.

The main research contribution to the project of the French team is (i) the construction of the robot in collaboration with French industry companies, (ii) the processing of the images and the control of the tele-operated system. The principal contribution of the Cypriot team was (i) the organization and coordination of the experiments which took place in Cyprus and (ii) the collaboration with the local partners for the correct operation of all the equipments and the whole system during the experiments. We may see that there are complementarities of the role of the two teams which is an important factor for the success of the collaboration.

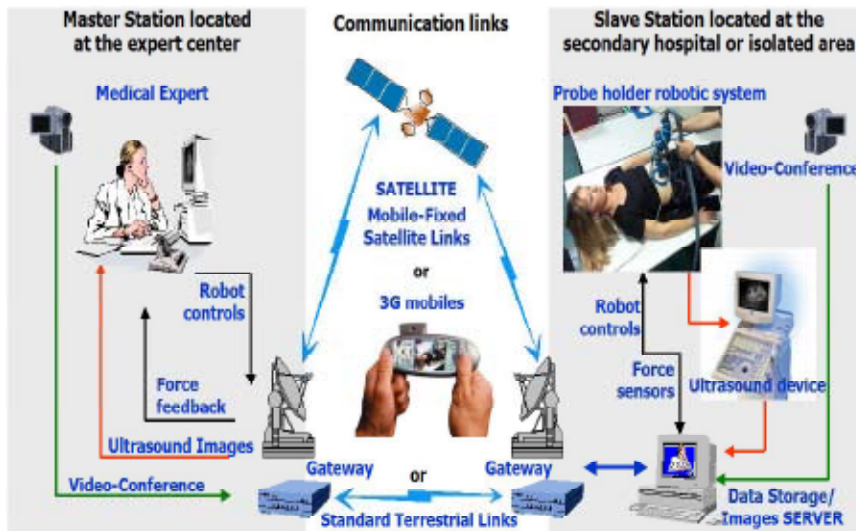
### **The research program in Tele-Echography**

#### **The Tele-Echography System**

The LVR developed a tele-echography chain which consists of 3 parts, as shown in the Figure. An ultrasound expert moves a fictive ultrasound probe like he would do in a standard echographic examination in his office. The instantaneous motion of the fictive probe is converted into an electronic signal which is sent via a communication link to the site where the patient is located. The patient site is equipped with an ultrasound device, a real probe and a probe holder robot. The light weight robot is held in an appropriate position close to the patient, by a paramedic. The robot receives the electronic signal sent by the fictive probe (through a communication link) and reproduces the motion made by the distant expert. The ultrasound device acquires the images generated by the real probe which are then sent to the expert side. A video conferencing system is also used to facilitate the communication between the two sites. So finally the expert doctor performs normally an examination to a patient located to a remote place or even abroad, by moving a fictive probe as if it was in contact with the patient. He performs in this way a diagnosis thanks to the ultrasound images that he receives from the patient site (acquired by the real ultrasound probe). All the data are exchanged between the two sites via a communication link which can be a fixed connection (e.g. ISDN or Ethernet) or a wireless connection (e.g. satellite or UMTS channels).

The first prototype robot arms were designed, constructed and validated by two research projects, the TERESA and OTELO which was a EU-funded project (2002-2004). Later new version improved robots were constructed and tested during the two phases of MARTE project. Now a new generation robot is at the final stage of construction and it is expected to be tested during the experiments of the next phase MARTE III.

Figure 1: The tele-echography chain



### The project MARTE

As it was mentioned before the MARTE project is a collaboration of the two institutions CUT in Cyprus and LVR in France, in which participate as partners many other organizations and private companies from Cyprus and France. The name of each partner will be given analytically in the next paragraphs. The general objective of the MARTE project is the validation of the usefulness of the whole Tele-Echographic system in the case of patients situated in isolated areas and under different conditions. The three main objectives which have been set within MARTE project are the following:

- Performance of clinical tests between two remote sides.
- Validation tests within a moving vessel for emergency cases (cruise, commercial or military ship)
- Validation tests within a moving vehicle for emergency cases (ambulance)

The communication links for the above tests were designed to be ISDN and Ethernet connection, UMTS and satellite channels according to the case. The study of each case consists of one phase of the MARTE project. The first case was the MARTE I. In this phase a patient in a small rural hospital in Kyperounta village on a mountain in Cyprus was examined by a medical expert in the General Hospital of Nicosia 75 km away [4]. The communication was performed with ISDN [2] connection. In phase II (MARTE II) a “patient” in a cruise ship in the Mediterranean sea was examined by medical experts in Cyprus and in France. The communication links were ISDN and satellite channels. The 3rd phase (MARTE III) which is not concluded yet is the examination of a patient in a moving ambulance using satellite communication channels.

### Partners involved in the project

The realization of these experiments requires the collaboration of specialized doctors and scientists. It is given below a list of all partners involved in the MARTE project in both countries.

In Cyprus:

- Cyprus University of Technology
- University of Cyprus
- Nicosia General Hospital
- Cyprus Telecommunication Authority
- E-Net LTD (Private Company)
- Tototheo Group of companies

- Louis Cruise Lines Company.

In France:

- University of Orleans –PRISM Institute, LVR Bourges
- Tours University Hospital
- Bourges Hospital
- Sinters Group
- Robosoft Company

### **Equipment Used**

It is given below a list of the main equipment used regarding mostly the telecommunication part related to the satellite communication.

- Satellite Land modem and Antenna.
- Sailor 500 Fleet Broadband Satellite Maritime modem and Antenna
- Polycom Video conferencing system

The collaboration of many partners and the use of specialized equipment was for the project a great advantage. Many technical problems could be solved easily, without long delays and also without extra cost. In addition to that the presence of many specialists during the validation experiments has improved significantly the quality of the results especially the transmission of the images regarding the tele-echography examination [3] and the video conferencing communication. But as can be easily understood, due to the great number of people involved in the project, there was often a problem of coordination of the various meetings. Fortunately this problem was overcome during the main experiment on the boat when all people were expected to be available for a whole week.

### **Educational Cooperation**

The educational cooperation between the two institutions CUT and University of Orleans started in 2005 and followed the beginning of the common research project MARTE in 2004. The two institutions signed a Bilateral Agreement for exchanges of students and academic staff in the framework of the European Erasmus program. The agreement was between the Electrical Engineering and Information Technology Department of CUT and the IUT (Institute Universite de Technology) department Mesures Physiques of Bourges which belongs at the University of Orleans. The major problem for both exchanges was the problem of language because the Cypriot students didn't speak French and French students didn't speak Greek. So the solution found was that the students of both Institutions do in the host institution their final year project under supervision in English language. In the same way the visiting staff was giving lectures at the host institution in English language which is spoken at a satisfactory level in both universities.

Main fields of the projects undertaken until now are the use of MatLab, FPGAs and Computers in engineering applications. These exchanges have been proved very successful for the time being and have strengthened the educational collaboration of the two institutions. Usually we have exchanges of two students and one professor per university per year. In addition to that in 2009 a visit of eight students from CUT and also from other universities was organized in IUT Bourges. During the visit the Cypriot students had the opportunity to come in contact with the local students, to visit the university and especially the Laboratories, to visit various factories in the area and to participate in a two days seminar about different topics like European Integration, the Bologna Process, Telemedicine, Literature and others. Various educational projects are on the way to be organized for the near future increasing mobility which is one of the main targets of the Bologna Process [1]. More comments about further activities will be given in another paragraph.

### **Financial aspect of the two programs**

#### **The research program**

The two phases of the program MARTE were financed by different sources. The various expenses were covered by

the governments, the universities and private companies. An analytical list is given below:

1. The governments of Cyprus and France, through the research organizations RPF and Egide financed all travel expenses for the researches in all three phases of the project. RPF is a Cyprus governmental research organization and it stands for Research Promotion Foundation and Egide is a similar organization in France.
2. The two institutions CUT in Cyprus and IUT Bourges in France financed the necessary expenses for the acquisition of the required equipment as well as part of the expenses for the satellite communication.
3. The Cyprus Telecommunication Authority (CYTA) financed the other part of the satellite communication and provided staff for technical assistance for the experiments without extra cost.
4. The two private companies E-NET and Tototheo rented equipment and provided staff for technical assistance without additional cost.
5. The Cypriote Cruise Company Louis during one of its Cruises in the Mediterranean sea has hosted a part of the research team and the appropriate equipment on the boat for a week during which it took place the main experiment of the tele-echography in MARTE II. All the expenses were covered by the Louis Cruise Company.

### **Educational program**

As explained before the educational activities were organized under the European Program for Lifelong Learning Erasmus. This program finances the majority of the expenses of the student and staff exchanges. In general the program grants for staff exchange cover almost all the expenses. On the contrary the grants for student exchanges do not cover all the student expenses and so the students always need to contribute a part of their expenses. Never the less until now the financial problem was not a major obstacle for the exchanges. We note that the two institutions provided to students all the facilities required making their studies and staying easy.

### **Further developments**

The next phase of the project, MARTE III comprises validation tests for the examination of a patient in a moving ambulance. The examination will be done from a medical centre in Cyprus and a medical centre in France. In this experiment a new generation robot will be tested. The communication between the equipment in the moving ambulance (the robot system and video conferencing system) and the medical centers in Cyprus and France will be done using Satellite channels. The research will be focused not only on the operation of the new improved robot but also on the quality of the transmitted images. Other ideas for validation of the whole system are test experiments in aircrafts and sub marines.

In the field of educational collaboration of the two institutions new activities are programmed for the near future. The next activity which is planned is the organization in the framework of the Erasmus program of an Intensive Program (IP) of a series of lectures in the field of Telemedicine. This will give the opportunity to the two institutions to transfer to the students the knowledge and experience acquired during the research program MARTE. In this IP project, according to the regulations of the Erasmus program, students from at least one more university should be invited to participate. Another activity which is planned is the collaboration of the two institutions for the organization of joint Degrees and Doctorates.

### **Conclusion**

The cooperation of the two institutions CUT in Cyprus and University of Orleans in France, in research and educational programs was described and commented. The research project MARTE gave the opportunity to the two research teams to collaborate and perform successfully various state of the art tele-echography experiments as explained before. Important factors for the success of this project were the complementarities of the research teams, the involvement of many scientific partners, the use of high tech equipment, the availability of sufficient financial resources and facilities and most of all the friendly collaboration of all the researchers, doctors, technician and other people involved. Besides the scientific added value resulted from all phases of the project it must be noted the valuable experience acquired from the management of a program in which were involved many partners from different sectors public and private, in different countries. Fortunately problems of finding appropriate time for the meetings and experiments, and availability of the necessary equipment when required, were overcome without serious dif-

ficulties or long delays.

As regards the educational cooperation, the student and staff exchanges gave the opportunity to the participants to enrich their knowledge and experiences and to the two institutions to open new horizons for cooperation. As a result the two institutions are now planning not only to continue their exchanges but to extend their cooperation and organize additional new activities like intensive programs, joint doctorates, and student educational visits in each institution.

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