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Project Acronym: AMISS

Project Full Name: Active and Passive MIcrowaves for Security and Subsurface imaging

Marie Curie Actions

Mid-term Report

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Dr. FRANCESCO SOLDOVIERI

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CONSIGLIO NAZIONALE DELLE RICERCHE

Mid-term Report

PROJECT MID-TERM REPORT

Grant Agreement number:	269157
Project acronym:	AMISS
Project title:	Active and Passive MIcrowaves for Security and Subsurface imaging
Funding Scheme:	MC
Mid-term period report:	1st
Mid-term period covered - start date:	01/10/2011
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Name, title and organisation of the person in charge of the project for the beneficiary(ies):	Dr. FRANCESCO SOLDOVIERI CONSIGLIO NAZIONALE DELLE RICERCHE
Tel:	+39 081 7620651
Fax:	
E-mail:	SOLDOVIERI.F@IREA.CNR.IT
Project website address:	http://www.irea.cnr.it/index.php?option=com_k2&view=item&id=

1. GENERAL PROGRESS OF THE PROJECT

The project has fully achieved its objectives and technical goals for the mid- term period;

Qualitative indicators of progress and success in line with workplan and milestones (description of progress towards milestones and deliverables)

The activities of the project are in line with the expected outcomes as far as the milestones and the deliverables, mostly expected after the first periodic report.

The only milestone expected in the first 9 months was M4.1. Such a milestone was concerned with the availability of the first release of the website; this milestone has been achieved. In fact, the first release of the website of the project is available at the website of IREA-CNR, the coordinator of this IRSES action, at address

http://www.irea.cnr.it/index.php?option=com_k2&view=item&id=342:progetto-amiss&Itemid=153&lang=it

• The AMISS website is organised as follows. The first page contains the abstract of the project and at this page there are links to other pages describing:
• Objectives of the project;
Partners;
• Plan of work;
• News and achievements;
• Publications ;
• Milestones;
• Workshop and Conference (attendance and organization);
• All the sections are continuously updated on the basis of the information provided by the partners.

As other main expected management activity, the Kick-off Meeting was held on November 3, 2001 and the main items of the KOM were:
1) The presentation of expertise of the partners, related to AMISS activities, for a first knowledge exchange (few slides were provided and presented from each partner)
2) Description of the scientific/technical activities and expected outcomes for each WP of the AMISS project (the presentation was given by Francesco Soldovieri, AMISS scientific Coordinator)
3) Description of financial aspects (presentation given from Dr. Francesca Di Matteo appointed from the Coordinator as the person having in charge the administrative and financial issue of AMISS project)
4) Definition of a procedure to identify the key persons in the project (technical and administrative management).

The appointment of the key persons was carried out after the Kick-off meeting on the basis of a proposal made by the Scientific Coordinator; this proposal was agreed by all the partners, which also identify from their part the key person in the Project Management Team. The final outcome of the appointment of the key persons is detailed in the section 3 Project Management.

About technical activities, the details of the progress towards the achievements of deliverables and milestones are given in detail for each Work-package-

WP1 Microwave and Millimetre wave imaging systems for security

In this first part of the project, the planned activities in WP1 have been started with technical cooperation between YTU and BMSTU. On this scope, the possibilities of use of dielectric loaded waveguide and horn antennas and their array configuration for wideband microwave through-wall imaging system (Task 1.2) have been discussed for better range and range resolution performance. Also, for task 1.2, activity has been started by CNR for the development, adaptation and improvement of the microwave tomographic approach for Through-Wall-Imaging so to comply with the requirements of the system developed by BMSTU.
Moreover, YTU has started the development of waveguide and horn array fed parabolic reflector antenna for radiometric passive millimetre wave imaging system, in cooperation with SRC (Task

1.1).
It is planned to submit the deliverables of D1.1 and D1.3 at the first periodic report (18th month).

WP2 Development of GPR technologies for subsurface sensing
and critical infrastructure monitoring

In this first part of the project, the activities in WP2 have been mostly preparatory, because the joint work will take place in the second and third year of the project.
Technical cooperation between YTU and IRE concerning the connected Tasks 2.1 and 2.2 has started in line with the planned time line for deliverables D2.1 and D2.2, which are due at PM 21. With regard to Task 2.3 YTU has started the development of the novel ultrawide band TEM horn antenna and GPR system with IRE according to the plan for deliverables D2.3 and D2.4, expected at PM 30. The collaboration between CNR-TUDELFT- YTU- IRE-USP will be initiated by YTU and IRE when they will be ready for the prototypes in the multichannel and arrays modes of GPR operation. In Tasks 2.3 and 2.4 CNR has started collaboration with IRE and BMSTU, respectively, to develop tomographic and other inversion methodologies dedicated to data coming from differential GPR and holographic radar for subsurface imaging. Deliverables D2.5 and D2.6 are expected without delay. First activities in Tasks from 2.5 to 2.8, mainly concerned with the development and adaptation of state of art and novel linear and non-linear inversion approaches, have been carried out with the final aim to make experimental validation in Task 2.9.

WP3 Radar technologies for remote detection and registration of vital signs

In this first part of the project, the technical activities of WP3 are in line with the overall expected outcomes of this WP.
In particular, while the technical cooperation between CNR and BMSTU concerning Task 3.2 has started (see below), the technical cooperation between BMSTU and YTU concerning Task 3.1 will start in late June, due to the fact that the two institutions are finalizing the relevant literature and state of the art review that they are carrying out separately.
After completing the state of the art review, the institutions involved in Task 3.1 are in the process of tackling the first aspects of the system design. This is fully consistent with the planned timelines.
As far as Task 3.2 is concerned, the starting period of the project has been already fruitful, since two different processing methodologies, independently developed by CNR and BMSTU, have been applied and compared in a laboratory controlled experiment carried out at BMSTU using a bioradar system previously developed by that institution. This software provide the first basis to build the material required by deliverable D3.2. and D3.3. About the Task 3.3, attention will be focussed in the next months, not only to vital signs but even to identify behaviour related to stress factors thanks to radar observations.

2. PROJECT ACHIEVEMENTS

Scientific highlights and research achievements:

The scientific activity and research achievements are given for each technical WP of the project as reported in the following.

WP1,

• Preliminary design discussions on wideband holographic GPR module between YTU and BMSTU, to achieve higher range and resolution for practically useful TWI system development.

• Design of a waveguide array to feed a parabolic reflector. The main aim of this design is to obtain desired radiation characteristics for air and coastal microwave surveillance radars and radiometric passive millimeter wave imaging system.

• Understanding of passive radiometric imaging system and its sub-modules such as antennas, receiver and image processing, in collaboration with SRC and YTU. Performance enhancement is aimed at further steps of the project.

• Development of a microwave tomographic approach, by CNR, for the data processing of the Through-Wall-Imaging system to be developed by BMSTU.

WP2

• Design and implementation of a Ultra Wide Band TEM Horn Antenna Designs for Ground Penetrating Impulse Radar. This activity is concerned with different design forms of TEM horn antennas such as, dielectric loaded, Vivaldi shaped and array versions for UWB GPR systems. Technological solutions have been identified to achieve high antenna gain, narrow beam and low input reflection characteristics over an ultra-wide band.

• Preliminary design and implementation of the differential GPR system at IRE, also thanks to the cooperation with YTU. This system is very useful to detect and characterize weak scattering targets and to make by erasing the strong contribution from the interface air/investigated medium that could “obscure” these targets.

• For this first period for Task 2.7 a new method has been developed for imaging GPR reflection data collected in multi-offset mode. The method can work with a minimum of required information about the subsurface and is capable of removing internal multiples. The one-dimensional version is shown to work and extensions to two- and three-dimensions are being developed. The output of this imaging algorithm is input for full-waveform non-linear inversion, which is the main objective of Task 2.8.

• For the first period, CNR has developed a linear inversion approach able to act in the “differential” GPR configuration. The method is based on a linear approximation of the electromagnetic scattering at microwaves and thus it is effective to operate in realistic conditions. Next step, in the second part of this periodic report, will be the experimental validation of the approach thanks to the data provided by differential GPR system of IRE.

• In this first period, CNR in cooperation with BSMTU has developed a linear inversion approach able to deal with the data provided by holographic radar systems so to achieve better performances in terms of resolution and focusing effects for a higher interpretability of the reconstructed images. First preliminary results of the inversion approach have been achieved at CNR in controlled conditions, thanks to the data provided by the RASCAN.4/4000 holographic radar developed by BMSTU. Next step will be concerned with a more assessed experimental validation of the proposed imaging approach and analysis of its performance thanks to the other systems of BMSTU.

WP3

• For this first period the main achievements has been the comparison for the bioradar signal

processing developed by CNR and BMSTU. As a matter of fact, the observed results have shown that these two independent processing tool are compatible for an integration as they provide comparable information achieved through different elaborations. As such, their perspective integration, also within a cross-validation framework, is a sound basis for the prosecution of the project's activities.

Transfer of knowledge and Training activities (workshops):

The transfer of knowledge is below detailed for the technical WPs.

WP1
The first transfer of knowledge activity which has started in this WP is between YTU and BMSTU to understand the operating principles of holographic GPR for its adaptation and development for TWI system.

Second transfer of knowledge activity has been started between YTU and SRC concerning the antenna and sub-modules designs for radiometric passive millimetre wave imaging system.

WP2
The main transfer has concerned the setting up of the most suitable acquisition geometry for measurements at the USP geophysical test-site on which data the developed processing technologies will be applied. This is the overall goal of WP2 (Task 2.9 and D2.8).
A good knowledge exchange occurred between IRE and YTU in the design of the differential GPR system, with a focus to the design of the antennas exploited in the system.
A good interaction is in course between CNR and IRE for the integration of the software developed by CNR in the differential GPR system.
A good interaction is in course between CNR and BMSTU for the integration of the software developed by CNR in the holographic radar.
Also, as not expected outcome of the project, it is at a finalization stage the appointment of Francesco Soldovieri (CNR) as co-adviser of a PhD student of USP, whose advisor is Prof. Porsani. The activity of the PhD student falls within the frame of AMISS action since it is concerned with development of linear and non-linear inversion approaches for GPR data processing in archaeology and forensics.
WP3
The main transfer has concerned the tailoring of the CNR processing tool to be applied to the BMSTU bioradar. This is a necessary step to foresee the integration of this software tool in the system whose design is the overall goal of the WP (Task 3.3 and D3.3).

Dissemination of results (conferences, publications...):

A first dissemination of the results have been performed by means of participation to the conferences and publication of the paper related to the project's scientific outcomes. In the following, we report only the journal papers and conference proceedings/presentation that have explicitly the acknowledgment to AMISS project. Of course, these documents are not fully exhaustive of the dissemination of AMISS activities, which are the subject of many other papers and presentations.

Papers on International Journal

A paper regarding the exploitation of a linear inversion approach in Archaeology prospection has been accepted for the publication on as ISI journal International Journal of Antennas and Propagation

F. Soldovieri, E. Utsi 2, R. Persico, and A.M: Alani" Imaging of Scarce Archaeological Remains using Microwave Tomographic Depictions of Ground Penetrating Radar Data"

A second paper is under revision on International Journal of Antennas and Propagation and is concerned with the joint activity BMSTU-CNR in the frame of radar systems for vital signs characterization and detection

F.Soldovieri, I. Catapano, L. Crocco, L. N. Anishchenko, S.I. Ivashov, "A feasibility study for Life

Signs monitoring via a continuous wave radar”

The one-dimensional imaging scheme that eliminates internal multiples is being prepared for publication in an ISI indexed scientific journal.
Conference Proceedings

I. Catapano, M. Bavusi, A. Loperte, L. Crocco, and F. Soldovieri, “On the combined use of radar systems for multi-scale imaging of transport infrastructures”, oral presentation given at European Geophysical Union General Assembly 2012, April 2012. EGU GA is the largest Conference in the fields of the geophysical science and it is a goo site for the dissemination of scientific activities.

3. PROJECT MANAGEMENT

Overview of the activities carried out by the partnership; Identification of problems encountered and corrective action taken:

As first activity, the Kick-off meeting held on November 3, 2011, was organised by CNR via skype conference; the meeting was focused on the definition of the main guidelines for the start-up of the project.
Within the meeting were pointed out the objectives of the project, the activity of each work package, the secondments and were reminded the rules for the participating and for the access to the distribution of funds.

Subsequently, the Partnership approved the appointment of the roles proposed by the Coordinator:
- Francesco Soldovieri as scientific responsible of the overall project
- Francesca Di Matteo as Project Administrator, in order to support the activity of the Coordinator and the PMT

And the following work-package managers:

- Ahmet Turk - YTU
WP1 Microwave and Millimetre wave imaging systems for security:

- Evert Slob - TUDelft
WP2 Development of GPR technologies for subsurface sensing and critical infrastructure monitoring:

- Lorenzo Crocco - CNR
WP3 Radar technologies for remote detection and registration of vital signs.

- Francesca di Matteo, for the administrative aspects and Ilaria Catapano (CNR) for the support to the scientific aspects of the management.
WP4 Project Management

Finally, the Partnership approved the following Project Management Team members:

- Francesco Soldovieri – CNR
- Evert Slob – TUDelft
- Ahmet Serdar Turk – YTU
- Gennadiy P.Pochanin – IRE
- Alexander Denisov - SRC
- Renato Prado - USP
- Sergey Ivashov - RSLab, BMSTU

The pre-financing, with the exception of a percentage of 3% that has been retained by the Coordinator for management budget, as decided in the Partnership Agreement, has been distributed by CNR early after its receiving by the EC among CNR, TUDelft and YTU, the three UE member or associated countries of the AMISS project.

A continuous flow of information has been activated between the AMISS management and the Project Officer with the main aim to have clear information about mobility modalities in response to the issues raised by the partners.

An updated secondments plan is in course of finalization and will be presented for the approval to the first year meeting.

A flyer depicting the main features and outcomes of AMISS is under development and will be presented at the first year AMISS meeting.

Also, as further activity of MGT the continuous updating of the website in ensured according to the information provided by all the partners.

4. ADDITIONAL INFORMATION

Additional information, which may be considered useful to assess the work done during the reporting period:

This first part of the project has been characterised by a good interaction and knowledge exchange between the partners; also, a right subdivision of the work has been made so to comply with the expected advances in hardware and software development.
About the hardware, the activity consisted of not only of preliminary design of the instrumentation but even of first implementation/realization of technological solutions. For the modelling and data processing aspects, thanks to the significant expertise of the partners, it was possible to achieve relevant advances for data reconstruction/inversion approaches. These approaches are able to account in an accurate way the electromagnetic phenomenon of the scattering and propagation and accordingly ensure performances at least comparable with the state of art techniques.
Also, the knowledge exchange between the partners more involved in the development of the instrumentation and the ones more interested to data processing is an enabling factor in the development of systems able to deal with realistic situations with the aim of a fast and accurate diagnostics.
As stated in the proposal writing and set-up, the technological outcomes of AMISS have a notable and widespread impact in many sectors of the society where the necessity of reliable and effective tools for non-invasive diagnostics and monitoring s clear, such as: physical security, forensics, civil engineering diagnostics and critical infrastructures monitoring; subsurface prospecting, archaeology and cultural heritage diagnostics,….

Attachments	Iceberg_KOM.pdf, CNR_financial_aspects_KOM.pdf, USP_Iag_KOM.pdf, CNR_KOM.pdf, BMSTU_KOM.pdf, CNR_ScientificActivities_KOM.pdf, TUDelft_KOM.pdf, IRE_KOM.pdf

Date:

Person in charge of the project for the beneficiary(ies):