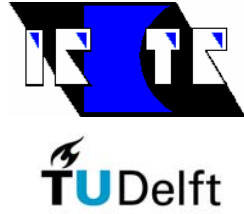




UGR



## **Advanced Short Course on Ground Penetrating Radar (GPR): Fundamentals and Applications**



**University of Granada, Spain**

***January 24-26, 2007***

**Course Directors**

Prof. R. Gómez Martín, University of Granada (UGR), Spain

Prof. A. Rubio Bretones, University of Granada, Spain

Prof. Alexander G. Yarovoy, IRCT, TUDelft, The Netherlands

# **Ground Penetrating Radar (GPR): Fundamentals and Applications**

*University of Granada, Spain, January 25-26, 2007*

**ORGANIZED BY :**

**Electromagnetism and Material Dept., Faculty of Sciences**

**University of Granada, Spain**

<http://maxwell.ugr.es>

**&**

**Research Centre for Telecommunications-Transmission and Radar**

**Delft University of Technology, the Netherlands**

<http://www.ircetr.tudelft.nl>

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**University of Granada, TU Delft, Tohoku University (Japan) and ACE – European Network of Excellence on Antennas**

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## **OBJECTIVES**

To provide up-to-date information on recent challenges in GPR technology and applications. Specific topics include Electromagnetic and GPR fundamentals, numerical simulations, subsurface imaging, as well as landmine, geophysical (hydrogeophysics, stratigraphic, and hydrocarbon exploration) and archaeological applications. The course is addressed to advanced (postgraduate) students, PhD students and GPR users with a technical background.

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## **SHORT COURSE CONTENTS AND SCHEDULE**

The course is organized as a series of five topics. Lecturers will be available during the two days for additional and/or individual discussions. A full description of the lectures with links and references can be found in the short course website.

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## **LECTURERS**

Prof. Rafael Gómez Martín, Universidad de Granada, Spain

Prof. Amelia Rubio Bretones, Universidad de Granada, Spain

Prof. Alexander Yarovoy, IRCETR, TUDelft, the Netherlands

Prof. Evert Slob, Department of Geotechnology, TUDelft, the Netherlands

Prof. Motoyuki Sato, CNEAS, Tohoku University, Japan

Dr. Dean Goodman, Geophysical Archaeometry Laboratory, Indiana University, USA

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## **COURSE TOPICS**

### **Electromagnetic fundamentals of the GPR**

**by Prof. R. Gómez Martín and Prof A. Rubio Bretones: 4 hours**

Basic electromagnetic theory: Maxwell's equations and constitutive equations. Electromagnetic wave: propagation in lossy media, reflection and transmission at material interfaces. Electromagnetic properties of common GPR media. Introduction to GPR: Transmission of energy from the transmitter to the receiver. Resolution and penetration. Basic antennas. Survey design. Numerical simulation: Time-domain analysis. FDTD method, integral equation methods and hybrid methods. Examples of application.

### **GPR antennas and instrumentation**

**by Prof. A. Yarovoy: 4 hours**

Basic knowledge on different GPR designs (video impulse radar, stepped-frequency radar, noise and MLBS radars) and principles of their operation. Link between radar performance and major technical specifications of a GPR. Demands for GPR antennas, overview of GPR antennas used in practice (resistively loaded dipole, bow tie, TEM horn and spiral antenna), physical processes behind their operation and characterization of their performance.

### **Signal processing: velocity analysis, 3-D imaging, anomaly detection**

**by Prof. M. Sato: 2 hours**

GPR signal contains rich information, and in many cases, we can use the raw GPR profile to understand the subsurface condition. However, appropriate signal processing yields much easier understanding of the information. In this section, I introduce the following topics: vertical velocity analysis by CMP profiling and application to quantitative analysis for hydrogeology, migration processing for clutter reduction, and accurate location algorithm for buried pipes and other anomalies.

### **Advanced imaging, image validation, and upscaling of soil/rock properties**

**by Prof. Evert Slob, 4 hours.**

Fixed-offset and multi-offset imaging and inversion of single and multi-component data. Image model validation with simulated imaging or simulated inversion methods. Demands on GPR system and acquisition configuration. Examples from hydrogeophysics and stratigraphic GPR applications in sedimentology and hydrocarbon exploration. Overview of the role of small-scale physical properties on macroscopic properties, mixture rules for multi-phase, multi-component media.

### **Hydrogeological and archaeological applications**

**by Prof. M. Sato: 2 hours**

In this section, I introduce applications of GPR from our recent research topics. The first application is hydrogeology. Temporal variation of the ground water condition can be monitored by GPR, and it can be also used for hydraulic parameter estimation. The second application is archaeology. Non-destructive survey by GPR will provide rich information before excavation. However, careful design and interpretation is required. I will introduce archaeological survey examples from Sendai (Japan) and Luxor (Egypt).

### **Application of the commercial software GPR-Slice to Archeology**

**by Dr. Dean Goodman: 2 hours**

For details about the software see [www.GPR-SURVEY.com](http://www.GPR-SURVEY.com)

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## LOCAL ORGANIZATION COMMITTEE

Dr. S. González García, Dr. M. Fernández Pantoja , Carlos Moreno de Jong van Coevorden, Rafael Gómez López

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## REGISTRATION FEES

The regular registration fee is 300 €. This includes lectures notes, copies of slides and coffee breaks. Student grants and reduced rates (200 €) are available through **University of Granada** sponsoring. Please include documentation of your student status with your registration. Hotel accommodation at discount rates is also available. Please consult the short course website or email the organizers.

A 10% discount (30 €) for early registration (**before 30 September 2006**).

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## REGISTRATION DEADLINE: **20 November 2006**

After the deadline date, full payment is required if the registration is cancelled. The course could be cancelled if the number of registrations is not sufficient by the deadline date. In this case, confirmed registrations fees will be refunded.

Registration after 20 November will be charged 10 % extra (30 €)

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## SHORT COURSE INFORMATION AND WEBSITES

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Fax: +34-958-242353

<http://maxwell.ugr.es>

[www.antennasvce.org](http://www.antennasvce.org)

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## DOCUMENTATION AND LATE REGISTRATION

The delivery of documentation will take place at the Science Faculty in the University of Granada in the afternoon of 24 of January. **At this time late registration is also possible.**

