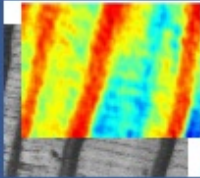


# **Virtual Fields Method Course**



# The Virtual Fields Method

## Extracting Constitutive Mechanical Parameters from Full-field Deformation Measurements

Course at University of Trás-os-Montes e Alto Douro, Vila Real, 8 July, 2013

### Course description

Full-field measurement techniques are gradually becoming routine procedures in industrial and academic mechanical testing labs thanks to the wide range of commercially available systems. Having access to the spatial distribution of strains at the surface of the material (or sometimes in the bulk, as in Digital Volume Correlation from X-ray tomography or OCT reconstructed volumes) enables the use of more complex test configurations to identify the mechanical behavior of materials, with the potential of tackling difficult problems like heterogeneous materials (welds, locally damaged composites, multi-materials, functionally graded materials etc...) or complex constitutive equations (viscoplasticity at high strain rate, hyperelasticity, phase changes as in SMAs etc...). However, in this case, the data processing is not straightforward and inverse problem resolution is usually required.

The present course will introduce the participants to a tool specifically developed to solve the above problem, the so-called Virtual Fields Method (VFM). This method is an alternative to Finite Element Model Updating over which it has a number of specific advantages, among which much shorter computation times. The idea of the course is to start from scratch on the subject and gradually lead the participants to an understanding of the basic concept of the method through simple examples in linear elasticity. The VFM will then be explored in more depth to demonstrate how it can be applied to non-linear constitutive laws, heterogeneous materials, etc. The important issue of virtual fields selection will also be briefly addressed. Finally, the course will be concluded by examples of application of the VFM to many different materials and situations. A GUI VFM-based software (<http://www.camfit.fr>) will also be demonstrated and a copy handed to each participant.

### Who Should Attend

Engineers and researchers who have an interest in the use of full-field strain measurements to extract mechanical properties of materials. Although inverse problems are usually considered to be mathematically demanding, this course will focus on rather simple concepts that will not require any specific mathematical background. Basic solid mechanics training (graduate level) is enough to benefit from the course. Participants can submit their own application/problem to the instructor for advice or even their own measurements for processing with the VFM.

### Course Handouts

The participants will be given a Pen Drive containing the slides used for the presentations, a set of scientific papers relevant to the subject as well as the CAMFIT software. There will also be an option for the participants to buy the author's book on the Virtual Fields Method (VFM) at a reduced rate (published by Springer, 2012).

### Instructor

Fabrice Pierron is currently Professor of Solid Mechanics at the University of Southampton, UK. He is a world-leading expert on novel strategies for identification of mechanical behaviour of materials based on heterogeneous tests, full-field measurements and inverse identification. In particular, he has been instrumental in the development of the Virtual Fields Method ([www.camfit.fr](http://www.camfit.fr)) and is a co-author of a recent book on the VFM (Springer). Prof. Pierron has published over 75 ISI referenced journal articles and co-authored more than 200 conference papers. He is currently Editor-in-Chief of Strain (Wiley) and holds a Wolfson Research Merit Award from the Royal Society.

### Course Schedule

9:00	Introduction on Identification of Material Properties
9:30	Introduction to the Principle of Virtual Work
10:30	Coffee break
11:00	The Virtual Fields Method: Principle in Elasticity
12:30	Lunch
13:30	Complements on the VFM
	• Non-linear behavior of materials
	• Heterogeneous materials
	• Virtual fields selection
	• The VFM in dynamics
15:00	Coffee break
15:30	Practical Examples of Application of the VFM
	• Composite materials (elasticity, damage)
	• Metals and welds
	• Biological materials
	• Vibration (damping)
	• High strain rate testing
	• Camfit: a GUI VFM package
17:00	End of session

### Course Fees

The regular fee is 150 euros and the student fee is 50 euros. Course fee includes box lunch, course handout material and refreshment breaks. Lodging, additional food and other materials are not included.

### Contact

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CITAB is organising a course on the Virtual Fields Method at the University of Trás-os-Montes e Alto Douro (UTAD) that will

be take place on the 8th July 2013 (<http://home.utad.pt/~jmcx/VFMCourseUTAD/>). The course will be given by Professor Fabrice Pierron, who is currently Professor of Solid Mechanics at the University of Southampton, UK. Professor Pierron is a leading expert on novel strategies for identifying the mechanical behaviour of materials based on heterogeneous tests, full-field measurements and inverse identification. Professor Pierron has been active in the development of the Virtual Fields Method, or VFM ([www.camfit.fr](http://www.camfit.fr)) and is a co-author of a recent book on this methodology (Springer). Prof. Pierron has published over 75 ISI journal listed articles and co-authored more than 200 conference papers. He is currently Editor-in-Chief of Strain (Wiley) and holds a Wolfson Research Merit Award from the Royal Society.

more information (PDF)