INTERNATIONAL DIGITAL IMAGE CORRELATION SOCIETY

Overall Course Schedule
Monday, October 9, 2023

Morning Sessions

DIC 101	DIC 201	Model Validation and Material Testing 2.0
Practical Considerations for Good DIC Measurements	***Advanced DIC Concepts and Uncertainty Quantification***	***Validating FE models and finding material parameters using DIC***
part 1		
Elizabeth Jones Sandia National Lab	**Phillip L. Reu** Sandia National Lab	**Pascal Lava** MatchID
Amanda Jones Sandia National Lab	**Mark A. Iadicola** National Institute of Standards and Technology	

Afternoon Sessions

DIC 101	DIC 201	LSA Method
Practical Considerations for Good DIC Measurements	***Advanced DIC Concepts and Uncertainty Quantification***	***Using grids to measure 2D displacement and Strain***
part 2	part 2	
Elizabeth Jones Sandia National Lab	**Phillip L. Reu** Sandia National Lab	**Benoît Blaysat** Université Clermont Auvergne
Amanda Jones Sandia National Lab	**Mark A. Iadicola** National Institute of Standards and Technology	

INTERNATIONAL DIGITAL IMAGE CORRELATION SOCIETY

Monday, October 9, 2023, Full Day Class, 8:30 AM to 5:30 PM (Full Day)

DIC 101: Practical Considerations for Good DIC Measurements – What is in the Good Practices Guide.

Dr. Elizabeth Jones (Sandia National Laboratories). Dr. Jones received her PhD in Theoretical and Applied Mechanics at the University of Illinois at Urbana-Champaign. She is currently a senior member of technical staff at Sandia National Laboratories in Albuquerque, NM, where she applies DIC to study deformation of various types of materials under complex loading conditions and develops methods to use DIC data for FE model validation.

Dr. Amanda Jones (Sandia National Laboratories) Dr. Jones received her PhD in Theoretical and Applied Mechanics at the University of Illinois at Urbana-Champaign. She is currently a senior member of technical staff at Sandia National Laboratories in Albuquerque, NM, where she applies DIC to material characterization efforts and complex loading conditions/ specimen geometries/ size scales.

COURSE DESCRIPTION

The *Good Practices Guide for Digital Image Correlation* (GPG) defines the knowledge and skills required to conduct DIC measurements in conjunction with mechanical testing of a planar test piece. Furthermore, the GPG defines the knowledge required to obtain Level 1 certification. The GPG is available at https://doi.org/10.32720/idics/gpg.ed1. This course will delve into all the topics covered in the GPG in detail, focusing on practical applications of DIC rather than theory or algorithms. It is designed as training for new practitioners of DIC to supplement vendor-based training, and as a refresher course for those who will be taking the Level 1 certification exam.

Topics covered will include:

- Basic and fundamental 2D and Stereo-DIC concepts
- Design of DIC measurements
- Preparation for DIC measurements
- Camera calibration
- Test execution concepts
- Strain calculations and basic Virtual Strain Gauge size studies
- DIC processing techniques
- DIC reporting requirements

WHO SHOULD ATTEND

DIC users who would like a thorough review of the iDICs *Good Practices Guide for Digital Image Correlation* (GPG). People who will be taking the Level 1 certification exam.

INTERNATIONAL DIGITAL IMAGE CORRELATION SOCIETY

Monday, October 9, 2023, Full Day Class, 8:30 AM to 5:30 PM (Full Day)

DIC 201: Advanced DIC Concepts and Uncertainty Quantification

COURSE DESCRIPTION

The advanced DIC class will cover what is underneath and beyond the Good Practices Guide (GPG). The theme will be to understand where DIC errors come from and work through all the components in DIC that lead to the measurement errors. For example, how to pick a DIC lens and camera (and why), what are the associated errors with various lenses and how do you quantify them. Why does the GPG specify 3-5-pixel speckles? What are the underlying principles? Understanding the camera calibration and the parameters and what makes a good calibration. Where does the matching uncertainty come from?

Concepts of advanced uncertainty quantification on the DIC measurement will also be discussed including a thorough look at the 2D matching error magnitudes. Stereo-DIC errors and advanced virtual strain gauge studies will also be discussed.

COURSE CONTENT

- Uncertainty quantification: What influences my DIC measurement?
- Factors in selecting a DIC lens
- Selecting a DIC camera.
- What makes a good DIC pattern and why.
- Calibration: Understanding the parameters
- Calibration: What makes a good calibration
- 2D and pattern matching uncertainty.
- Stereo-DIC uncertainty quantification
- Understanding the VSG.

WHO SHOULD ATTEND

This course will go beyond the information needed for a Level 1 certification exam and target what is needed for Level 2 certification. All DIC users who would like to learn more about what influences their measurement accuracy.

Dr. Phillip L. Reu is a Distinguished Member of Technical Staff at Sandia National Laboratories. Phillip specializes in developing novel full-field measurement techniques in previously un-measurable regimes often using digital image correlation (DIC). Current research efforts in DIC are focused on uncertainty quantification. Phillip is the author of the “Art and Application of DIC” article series in the journal of Experimental Techniques, chair of the DIC Challenge, president of the International Digital Image Correlation Society (iDICs), and paterfamilias to 6 kids.

Dr. Mark A. Iadicola is a Staff Scientist at the National Institute of Standards and Technology. Mark 's research interests include advanced experimental methods in solid mechanics as applied to multi-axial plastic deformation and stress induced phase transformation, with special emphasis on sheet metal forming and shape memory alloys (e.g. Nitinol). Mark is vice president of the International Digital Image Correlation Society (iDICs), a USA/ANSI Delegate to various subcommittees of the ISO TC164 Mechanical Testing Committee, and an active Member of Committee E28 on Mechanical Testing in ASTM International.

INTERNATIONAL DIGITAL IMAGE CORRELATION SOCIETY

Monday, October 9, 2023, Morning Class, 8:30 AM to 12:30 PM (½ Day)

Model Validation and Material Testing 2.0 via Full-Field Data

COURSE DESCRIPTION

In this course, special attention is paid to the integration of DIC within the engineering design cycle: from material identification towards model validation with a quantitative interpretation of the results. It is illustrated how DIC uncertainties impact the identified properties and final model validation decisions.

At present, material testing is still mostly performed through standards developed for extensometers or strain gauges, using simple geometries with statically determinate stress states. These tests provide a limited amount of information per test and lead to the need for a large number of tests to calibrate a given material model. It is therefore essential to develop the next generation of data-rich image-based tests, coined 'Material Testing 2.0'. In this workshop, the underlying concepts will be outlined with a specific focus on the integrated use of DIC and the Virtual Fields Method (VFM) for the identification of anisotropic metal plasticity, hereby comparing results of MT2.0 with ASTM standards. It is demonstrated how DIC's resolution and spatial resolution might influence the final identified material properties. A methodology is presented to both evaluate the measurement performance and to optimize the test setup.

In a second slot, the validation of FEA simulations is approached via a levelling methodology that relies on the use of synthetic speckle image deformation to produce validation maps of finite element models from DIC data. The underpinning novelty is the fact that it considers the filtering effects of DIC which, according to MatchID, is a compulsory step to obtain robust validation.

The workshop is led by Dr. Pascal Lava from MatchID – Metrology beyond colors, Belgium. He brings a wealth of experience in the practical application/data analysis of DIC, the identification of mechanical material properties via the virtual fields method, and the validation of FE simulations.
His personal drive is to improve the general knowledge about DIC and its involved error sources – increasing the technique's range of credibility and applicability in a plethora of verticals. Pascal is author of more than 50 peer-reviewed journal papers and a fellow of iDICS.
http://www.matchid.eu

COURSE CONTENT

- Spatial resolution and resolution in DIC
- Material Testing 2.0: an introduction
- Use cases on Hill 48, Yield-2002 and other anisotropic material models
- Validating FEA simulations via a DIC-levelling approach: synthetic image concept, filtering and practical examples
- From FEA validation towards model updating

WHO SHOULD ATTEND

Practitioners of DIC at post graduate level working in both academia and industry. In addition, engineers and researchers who have an interest in the use of full- field strain measurements to extract mechanical properties of materials or validate FEA models. Basic knowledge of DIC is required.

INTERNATIONAL DIGITAL IMAGE CORRELATION SOCIETY

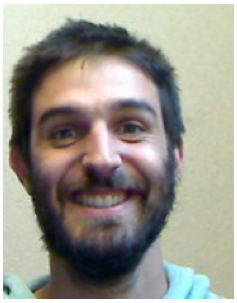
Monday, October 9, 2023, Afternoon Classes, 1:00 PM to 4:30 PM

The Grid Method

COURSE DESCRIPTION

The grid method is a technique suitable for in-plane displacement and strain measurement. It relies on a regular marking of the surface under investigation. The regular pattern acts as a spatial carrier, and the sought displacement components induce phase modulations of this carrier. Images of this regular marking, which progressively deforms during a test, can be advantageously processed with a spectral method. With the windowed Fourier transform, it is shown that displacement and strain components are obtained quasi-directly, which allows a fast and pixelwise determination of the displacement and strain fields.

This course aims at providing the principle of this technique, with a special emphasis on its theoretical foundation and metrological performance. Practical aspects concerning its implementation will also be discussed.



The workshop is led by
Dr. Benoît Blaysat (Université Clermont Auvergne)
Benoit.blaysat@uca.fr

Benoit Blaysat is an associate professor at the Clermont Auvergne University (Institut Pascal, France) since 2013. After a Ph. D. in computational mechanics (LMT Cachan, France), he decided to focus his research on experimental mechanics, more particularly on full-field measurement techniques and the related inverse problems raised by their use for material characterization purposes.

COURSE CONTENT

- Marking surfaces with grids
- Processing grid images to extract displacement and strain fields
- Recent examples of use in mechanics of material and structures
- Metrological performance: measurement resolution, bias, spatial resolution, relationship between these quantities. Link and comparison with subset-based DIC
- Tutorial: processing various sets of grid images with Matlab programs provided to the attendees

WHO SHOULD ATTEND

Engineers and researchers who are seeking an alternative technique of DIC, in particular in cases for which a good compromise between spatial resolution and measurement resolution is needed.