INTERNATIONAL
DIGITAL IMAGE CORRELATION
SOCIETY

Instructional Courses

In conjunction with the iDICs Conference an optional instructional day is offered for those interested in participating. These courses are taught by internationally known experts in the field of Digital Image Correlation (DIC). Instructors will address a variety of DIC related topics.

SCHEDULE

Monday, November 7, 2016

Full Day Course

9:00 AM – 5:00 PM
Title: ***General considerations in using DIC for material identification through VFM and FE model validation***
Instructors: Dr. Pascal Lava, MatchID
Dr. Marco Rossi

Morning Half Day Course

9:00 AM – 12:00 PM
Title: ***How to Pattern….Everything***
Instructors: Tim Schmidt, Trilion Quality Systems

Afternoon Half Day Course

1:00 PM – 5:00 PM
Title: ***Uncertainty quantification and standardization for DIC***
Instructors: Dr. Phillip L. Reu, Sandia National Laboratories
Dr. Mark A. Iadicola, National Institute of Standards and Technology

LOCATION

DoubleTree Philadelphia City Center
237 South Broad Street
Philadelphia , PA 19107
Third Floor Meeting Rooms:

- Aria
- Concerto

REGISTRATION FEES

Registered iDICs Conference Attendees

Full Day Registration Fee: $ 350.00
Half Day Registration Fee: $ 175.00, per course

Non-Conference Attendees

Full Day Registration Fee: $ 500.00
Half Day Registration Fee: $ 250.00, per course

To register, visit https://www.regonline.com/Register/Checkin.aspx?EventID=1852405

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General considerations in using DIC for material identification through VFM and FE model validation

Monday, November 7, 2016 9:00 AM – 5:00 PM

COURSE DESCRIPTION

Digital Image Correlation (DIC) is gradually becoming a standard tool in experimental mechanics, for both industry and academia. Despite the fact that the measurement system is often sold with the argument of being easy in use and setup, a poor understanding of issues arising in the whole measurement chain (imaging, noise, correlation algorithm, smoothing, …) can result in poor or misinterpreted results.

In a first slot, special attention is paid to the concept of resolution and spatial resolution in DIC. Both are investigated via practical examples on a step by step basis. This leads to general recommendations for reporting on DIC results.

Having access to the spatial distribution of strains at the surface of the material via DIC enables the use of more complex test configurations to identify the mechanical behavior of materials via the Virtual Fields Method (VFM). In a second part of this course the focus is on this method which 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 is to start from scratch on the subject and gradually lead the participants to an understanding of the basic concept of the VFM through simple demonstrated examples in linear elasticity.

In a next step, DIC and VFM are jointly studied and 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 final slot the abovementioned concepts are then adopted to get an intuitive feeling on how to validate an FEA model. Again, the ideas are outlined based on practical examples. The principal goal of this workshop is not to provide a detailed theoretical study on DIC, VFM and FEA validation, but to focus on possible problems and general concepts via practical examples.

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.

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COURSE INSTRUCTORS

The workshop is led by Dr. Pascal Lava from MatchID – Metrology beyond colors, Belgium and Prof. Marco Rossi, Marche Polytechnic University, Italy. Both bring a wealth of experience in the practical application/data analysis of DIC and the identification of mechanical material properties.

In June 2002 Pascal Lava obtained a master degree in mathematics at Ghent University. In 2006, he acquired a PhD in sciences - nuclear physics at Ghent University. Since January 2008, he worked as a professor at the department Metallurgy and Materials engineering (MTM) at Leuven University. His research topics included Digital Image Correlation (DIC) and material identification via virtual fields and finite element updating. Pascal Lava is author of more than 35 peer-reviewed journal papers and the founder and main developer of the DIC platform MatchID (http://www.matchidmbc.com) which transformed into a spin-off company since May 2015. Currently, he is fully employed as CTO within MatchID with specific focus on the use of DIC to calibrate material models and validate FEA simulations.

Marco Rossi obtained a master degree in mechanical engineering at Marche Polytechnic University (Italy) in 2003 and a PhD in mechanical engineering in the same university in 2006. In 2009 he worked for three years as post-doc at ParisTech with Prof. Pierron, where he focused on the study of the Virtual Fields Method (VFM) and its interactions with full-field measurement techniques (DIC, grid method). During his career, he also worked as visiting scholar and post-doc at University of Reading and at the Impact and Crashworthiness Lab of M.I.T. Since 2012 Marco Rossi is assistant professor at Marche Polytechnic University. His main research topic is material characterization using DIC and inverse methods (VFM, FEMU) and he is author of more than 30 papers on this subject.

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How to Pattern….Everything

Monday, November 7, 2016 9:00 AM – 12:00 PM

Course Description

Patterning is an essential part of every digital image correlation test setup. Although most users do avoid the worst-case scenario of "garbage in, garbage out" when it comes to patterning, there still seem to be a lot of non-optimum techniques and results in practice. Many users have concerns about their ability to produce high quality patterns without a lot of struggle, or a degree in Art. However, there are simple guidelines and methods that enable patterning to be a fast, easy and repeatable process, with straightforward quality metrics.

This course will cover everything you need to know to confidently and quickly prepare any specimen for a DIC test, and be sure that patterning will not be the limiting factor for obtaining the highest quality data.

Specific topics to be thoroughly covered include:

- The Golden Rules of Patterning
- Patterning for the Most Common Test Setups
- Removing Human Factors from Patterning
- Pros and Cons of Spray Paint, Ink, Rubber Stamps, Airbrushes, Markers….
- Masking Hows and Whys
- Pre-Test to Check Your Pattern (And Everything Else, Too)
- (System Noise as Opposed to DIC Noise)
- The Ideal Pattern Vs The Real World

And

- Most Common Beginner's Mistakes
- Bad Ways to Do Good Patterns
- Fantastic Examples of Terrible Patterning
- What to Do When Larger Dots Are Required
- Evolution of Various Patterning Methodologies
- Small-Scale and Microscale Patterning Techniques
- What About Naturally Occurring Patterns?
- High Temperature and Very High Temperature Patterning
- Some Lighting Techniques – How to Make Your Patterns Look GOOD

Who Should Attend

It is hoped that all current or potential users of DIC would benefit from this course.

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Course Instructor

Tim Schmidt, Vice President of Trilion Quality Systems, is one of the most experienced practitioners of 3D image correlation and point tracking photogrammetry in the world, particularly for field tests and high speed camera applications. Tim has run tests on days, nights and weekends for more than 14 years. He has given Basic, Refresher and Advanced training to hundreds of DIC users, and provides worldwide support for challenging measurements.

He received a Bachelor of Science in Engineering degree, with a major in Mechanical Engineering, from Cooper Union in 1989, with a four-year full scholarship. He conducted part-time postgraduate research with the Laser and Optical Engineering Research Group at the University of Aberdeen from 1994-1996.

Tim was Principal Investigator on Small Business Innovation Research Phase I and Phase II contracts from 2005-2008, “Revolutionary Materials Research Technology for High-Strain-Rate Ordnance Research”, sponsored by the Air Force Research Lab Munitions Directorate at Eglin Air Force Base, to develop high speed 3D image correlation for high rate Hopkinson Bar testing.

Tim was presented with a Silver Snoopy award by Astronaut Mike Foreman in November 2011, for his leadership of the Space Shuttle external tank photogrammetry team, which measured the behavior of the external tank as it was filled with liquid hydrogen and liquid oxygen at the launch pad. The Silver Snoopy is one of NASA’s highest honors, the astronaut’s personal award for professional excellence.

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Uncertainty quantification and standardization for DIC

Monday, November 7, 2016 1:00 PM – 5:00 PM

Course Description

Digital Image Correlation (DIC) is now a widespread engineering measurement tool used in industry, government and academic research. The rapid spread and adoption of this technique has emphasized the importance of understanding the metrological aspects of the measurement. This class will cover existing uncertainty quantification concepts and techniques as they apply to DIC, using the guide to the expression of uncertainty in measurement [1, 2] and other standard error assessment approaches. The use of reference materials, artifacts and methods will be discussed as related to assessing DIC bias and uncertainty. We will demonstrate the various error sources using real world examples and examples of how to measure and minimize errors for both 2D and stereo-DIC. We will describe both "bottom-up" and "top-down" approaches for assessing the quality of DIC results and present

The adoption of DIC within industry has led to need for standardization of the method. We will discuss current and ongoing standardization themes and efforts within the community to provide DIC guidance. As standards are specific to individual tests (e.g. tensile testing) and therefore not applicable to all situations, a second approach of providing "best practices" will also be discussed.

Course Instructors

The course is led by Dr. Phillip Reu of Sandia National Laboratory and Dr. Mark Iadicola of the National Institute of Standards.

Dr. Phillip L. Reu is a Principal Member of Technical Staff at Sandia National Laboratories. He has received an MS in biomedical engineering from Rensselaer Polytechnic Institute and an MS and PhD in mechanical engineering from the University of Wisconsin – Madison (2002). Phillip specializes in developing novel full-field measurement techniques in previously un-measurable regimes often using digital image correlation (DIC) or coherent optical measurement techniques. 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, international instructor in DIC techniques for "Metrology beyond colors", chair of the DIC Challenge, vice president of the international digital image correlation society (iDICs), and paterfamilias to 5 kids.

Dr. Mark A. Iadicola is a Staff Scientist at the National Institute of Standards and Technology. He received his MSE (1997) and PhD (2002) in Aerospace Engineering from the University of Michigan - Ann Arbor. Mark 's research interests include advanced experimental methods in solid mechanics (including digital image correlation for strain mapping, X-ray diffraction for stress measurement, infrared thermal imaging) 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 a board member of the International Digital Image Correlation Society (iDICs), USA/ANSI Head of Delegation to the ISO Subcommittee for Ductility Testing (SC2) - Mechanical Testing Committee (TC164), and an active Member of Committee E28 on Mechanical Testing in ASTM International.

1. BIPM, *Evaluation of measurement data – Guide to the expression of uncertainty in measurement.* JCGM 100:2008, 2008.
2. Possolo, A., *Simple Guide for Evaluating and Expressing the Uncertainty of NIST Measurement Results* in *Technical Note 1900*, NIST, Editor. 2015.