MatchID
Metrology beyond colors

MATCHID NEWS

Material Characterisation and Image Correlation Newsletter 1 April 2016

… metrology beyond colors?

As a measurement tool, Digital Image Correlation (DIC) is gradually becoming an accepted technique in both industry and academia. DIC allows full field, contactless measurement of deformations at the surface of any type of material and under arbitrary loading. Nowadays, DIC is still too often used in a qualitative manner rather than as a metrological tool, e.g. to detect strain localization, to detect crack formation or to visualize some deformation pattern. One of the reasons for this is that the post-processing of the images can be a daunting task for the less experienced user, yielding incorrect strain fields when not done properly.

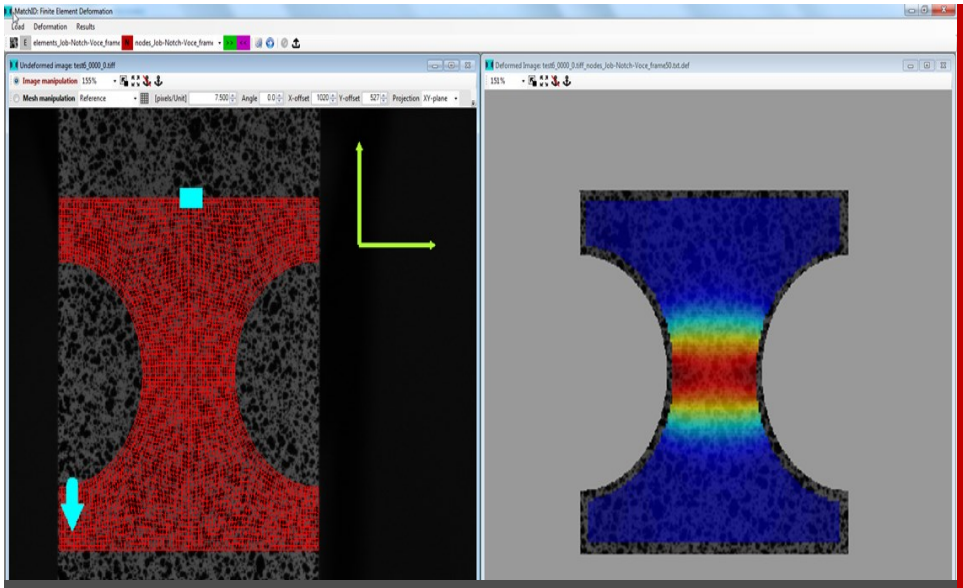
It is exactly on this aspect that MatchID improves; the tagline of MatchID is "**Metrology beyond colors**", offering the DIC system of the future where the main focus lies on the metrological aspects of the system:

- Interpretation of results in a quantitative way with integrated error assessment
- **seamless validation of simulations**
- Optimal test setups and processing: patterns, experimental tools and automated post-processing
- Customized application development
- In-depth training: annual courses by experts in the field

While the MatchID platform can be used simply as a measurement tool, it expands on this by seamlessly integrating virtual fields methodologies (VFM) which allow the **direct identification of mechanical properties** from the captured DIC images. This is done without the need for coupling to external FE software or time-consuming updating algorithms.

In summary, MatchID can support all stages in the engineering process from determination of material properties towards extended model validation.

This is the first one of hopefully a long series of newsletters. Please enjoy the reading!



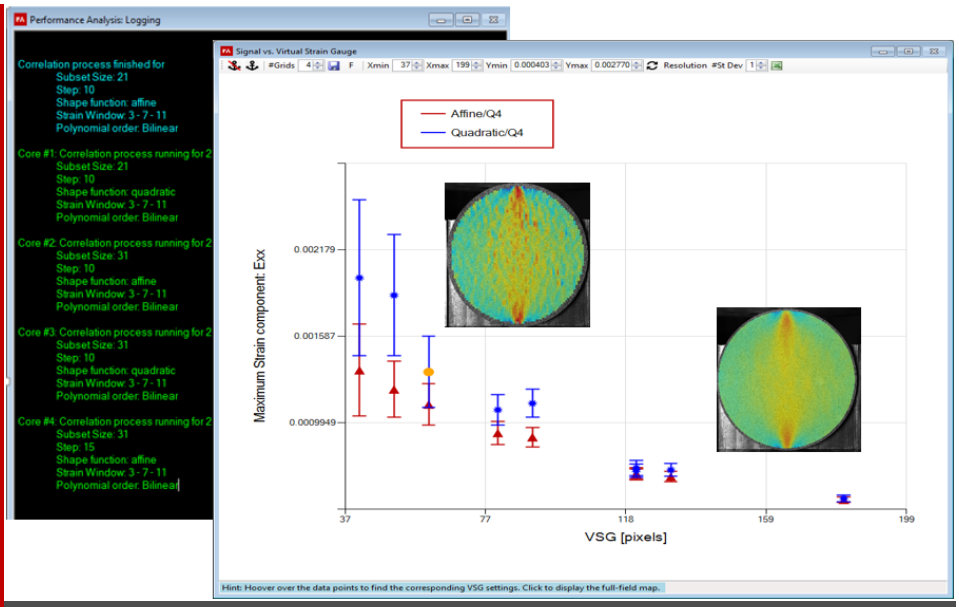
Establish a one-to-one relationship between model and experiment

In This Issue

MatchID 2016: What's new?

The new MatchID release 2016-v1 includes the following new available modules:

- **VFM Elasticity**: iso– and orthotropic linear elasticity in one single test
- **VFM Plasticity**: small strain isotropic plasticity with various hardening laws
- **FEA Deformation**: Establish a one-to-one relationship between model and experiment by adopting identical filtering
- **Performance analysis**: make a deliberate choice on DIC user settings to optimize your experimental analysis



Performance analysis module: Make a deliberate choice on DIC user settings. Notice the drop in signal when applying a larger VSG.

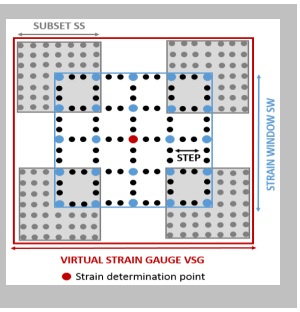
Module in the picture: Performance Analysis

Optical full-field measurement methods such as Digital Image Correlation are currently extensively applied to study the deformation characteristics of a wide range of materials. However, as holds true for finite element simulations, current DIC implementations are **highly dependent on the initial user input**: subset, step, shape function and eventual strain smoothing. As such, the measured displacement and strain fields should always be interpreted in view of the obtained resolution (noise floor) and spatial resolution.

As indicated in the figure above for an aluminum disc in compression, a larger virtual strain gauge will largely decrease the noise-floor of a strain measurement since more smoothing is adopted, at the expect however of a decreased maximum signal.

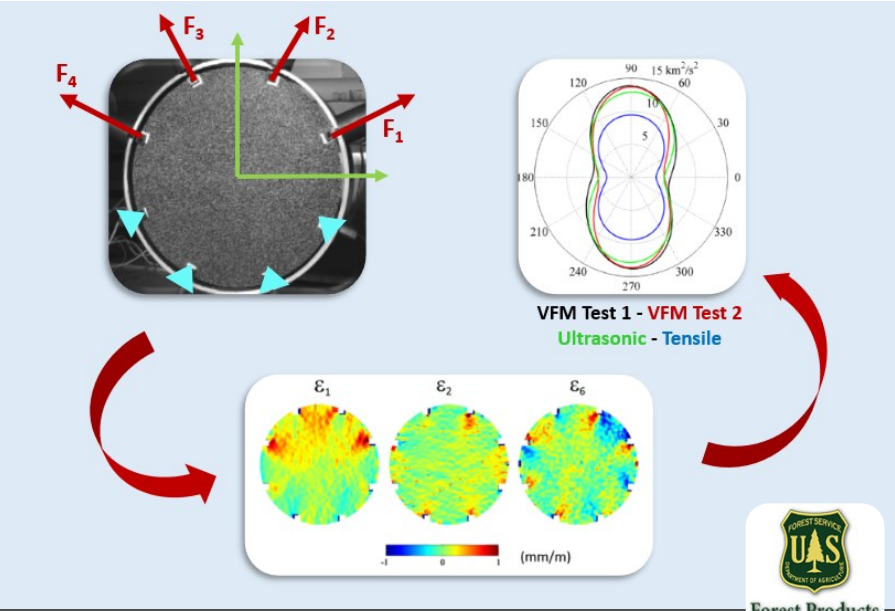
The virtual strain gauge (VSG), or area needed to calculate the strain, is not only determined by the number of displacement data points (Strain window – SW) involved in the smoothing, but also by the step (ST) and adopted subset (SS). A simple calculation based on the figure on the right generates

VSG = [(SW-1) x ST] + SS = 19 pixels^2



Parallel processing and automated chart generation

MatchID developed a performance analysis module that allows the user to make a more deliberate choice on DIC user settings for both 2D and stereovision applications. Parallel processing generates charts as displayed above in the blink of an eye. Full-field displacement and strain maps at various settings can instantly be consulted. Accordingly, this module allows the user to approach a DIC analysis in a more quantitative way in view of the aimed application. This is similar to a convergence analysis in FE computations, and an essential step to evaluate the quality of the data.



Anisotropic stiffness identification of paperboard at US Forest Service: from load fixture to strain fields to a polar plot of Q_{11}

Application in the picture: Paper & Wood

Scientists at US Forest Service, Forest Products Laboratory, David Kretschmann and John Considine, are working with MatchID to develop analyses for examination of heterogeneous stiffness in cellulose materials. Specifically, Kretschmann is **using MatchID to differentiate earlywood and latewood stiffness** from pith to bark and up and down the tree in Southern Pine. Comparison of those stiffnesses in intensively managed and non-intensively managed forests will be used to guide lumber grading standards. Eventually, Kretschmann hopes to suggest management practices which create high-value lumber.

"MatchID's expertise in appropriate DIC analysis and VFM have been an important aspect of my work"

- John Considine, US Forest Service

D. Kretschman (l.) and J. Considine (r.)

Considine **uses MatchID for identification of stiffness variation in structural paperboard**, a material used in fiberboard containers. Stiffness is a critical property in this material because failure often occurs due to local buckling. MatchID's expertise in appropriate DIC analysis and VFM have been an important aspect of this work. Quantification of stiffness variation is challenging in this paperboard because it can be caused by a variety of processing variables, including local fiber orientation, mass variation, dried-in stresses and a wide-range of fiber geometries and mechanical properties. Results of this work will be used to reduce and control stiffness variation. For more info: *Considine et al., Exp Mech 54 p.1395 (2014)*

Forest Products Laboratory, 1 Gifford Pinchot Drive Madison, WI 53711, USA, www.fs.fed.us

DIC course

June 13-17, 2016
Philadelphia, USA

Thanks to very successful previous editions, an intensive 5-day course on deformation measurements using Digital Image Correlation is proposed here. The course is organized by three well-known international experts in the field with a broad experience in a wide range of applications: Prof. F. Pierron, Prof. P. Lava and Dr. P. Reu. Although the course is supported by MatchID, it is platform independent.

"I did not know there was so much behind DIC"

- Participant 2014

Specific focus is on the metrological aspects of the system, with quantitative interpretation of the results and errors. Theoretical lectures are alternated with in-depth experimental labs and data analysis. A maximum attendance of 20 participants will be respected in order to optimize interaction with the instructors. In addition, the lab and data analysis sessions are organized in small groups of two to maximize the learning experience. After completing this course the participants will have acquired a high level of skill enabling them to use the technique in an informed way to produce quantitative results.

http://diccourse.matchid.org

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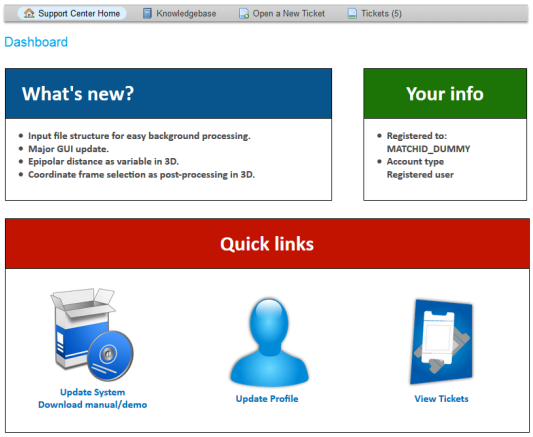

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