MatchID
Metrology beyond colors

MATCHID NEWS

Material Characterisation and Image Correlation Newsletter 2 November 2016

The complete engineering circle!

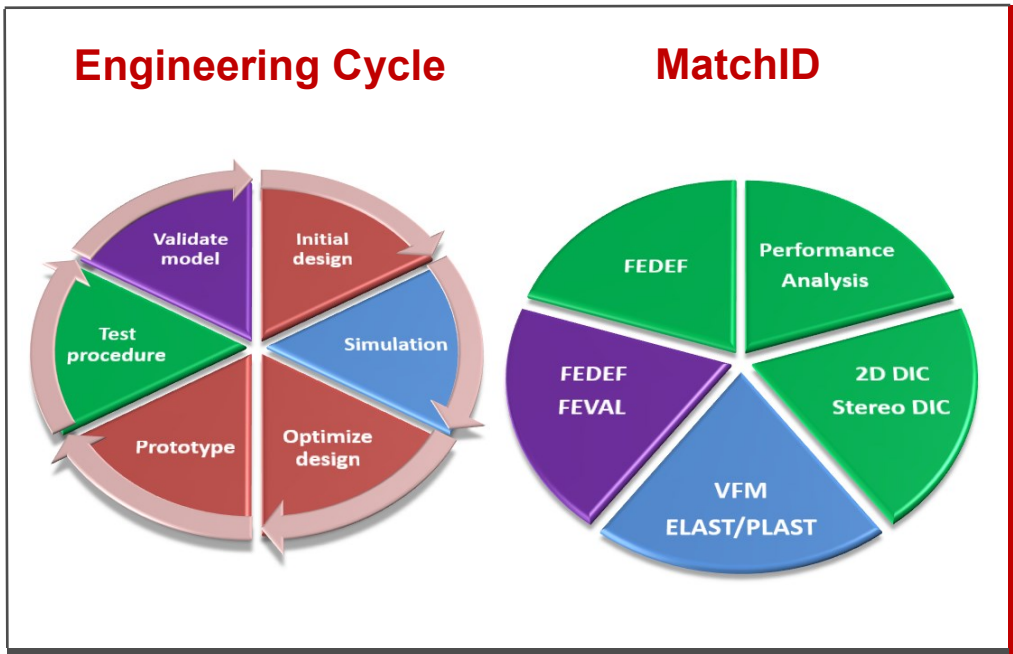
With the release of our stereo-deformation and finite element validation modules, MatchID has now reached the level of being **a complete DIC analysis package**. Indeed, our dedicated modules now support all stages in the engineering process from the determination of material properties towards extended model validation:

- MatchID 2D/Stereo: Standard DIC measurement tool with integrated error assessment.
- VFM Elasticity/Plasticity: 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.
- FEDEF: numerically deform images according to displacement fields that are obtained via finite element analysis. Easy workflow with fast algorithms generating images with double precision. Supported for 2D and Stereo. Set up virtual experiments and study the impact of e.g. camera angles on shape, displacement and strain reconstruction.
- FEVAL: finite element validation module. This module **does not simply subtract FEA data from DIC measurements but subjects them to identical filtering effects** and as such brings both the measurement and the simulation mesh to the same level.
- Performance Analysis: a DIC convergence tool allowing the user to make a more deliberate choice on DIC's user settings for both 2D and stereovision applications.

As such, MatchID has truly transformed from being an academic software platform into the DIC system of the future where the main focus lies on the metrological aspects of the system.

This is our second newsletter. For this issue a warm thank you goes out to Dr. Leslie Lamberson from Drexel University whose research group not only hosted our first DIC course in the USA in extremely well organized conditions, but also provided us with a nice application.

Please enjoy reading!



Our dedicated modules support all stages in the engineering design process

In This Issue

MatchID 2017: What's new?

The new MatchID release 2017-v1 includes the following new available features:

FE Deformation

Generate synthetic images based on FEA nodal displacements in the blink of an eye. Available for both 2D and Stereo.

FEA Validation

Establish a one-to-one relationship between model and experiment by adopting identical filtering. Direct generation of data rich validation maps.

Stress Reconstruction

A large library of material models directly converting measured strains into stresses.

Multi Camera

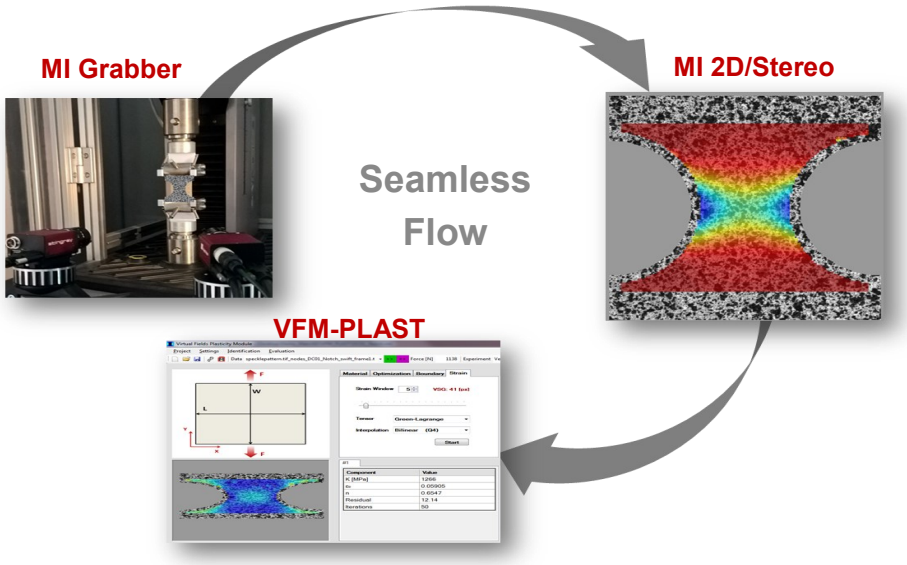
A multi (>= 3) camera platform with integrated stitching procedure. Results are expressed in one common coordinate frame.

High Speed Grabber

Frame grabber that allows communication/ synchronization with Phantom high-speed cameras. Alignment tools, subset evaluation and noise assessment.

Self-Training Material

Dedicated exercises to understand all steps towards a quantitative DIC measurement



VFM plasticity: Fast and accurate identification of yield criteria and hardening laws through a seamless communication with the experimental DIC data

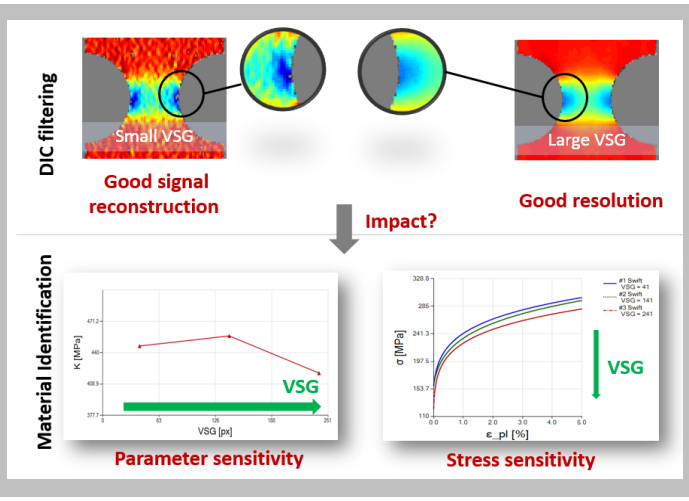
Module in the picture: VFM Plasticity

The Virtual Fields Method (VFM) [1] is an experimental-numerical technique aiming to identify mechanical properties from complex test configurations through optical measurements as e.g. DIC. The VFM has some clear advantages over more traditional techniques, amongst which a **reduced testing time/material usage** and identified properties **aligned with the actual product application** are the most important ones. It relies on the weak form of equilibrium between internal and external work. Hereby, the internal work receives input from DIC strain values connected to stresses via a constitutive law whereas the external work relates to the involved imposed and body forces. The VFM is integrated in MatchID through a seamless flow with our DIC measurement and analysis system and does **not impose coupling to third party applications**, making the identification extremely fast and precise, even in the case of complex material laws involving many unknowns.

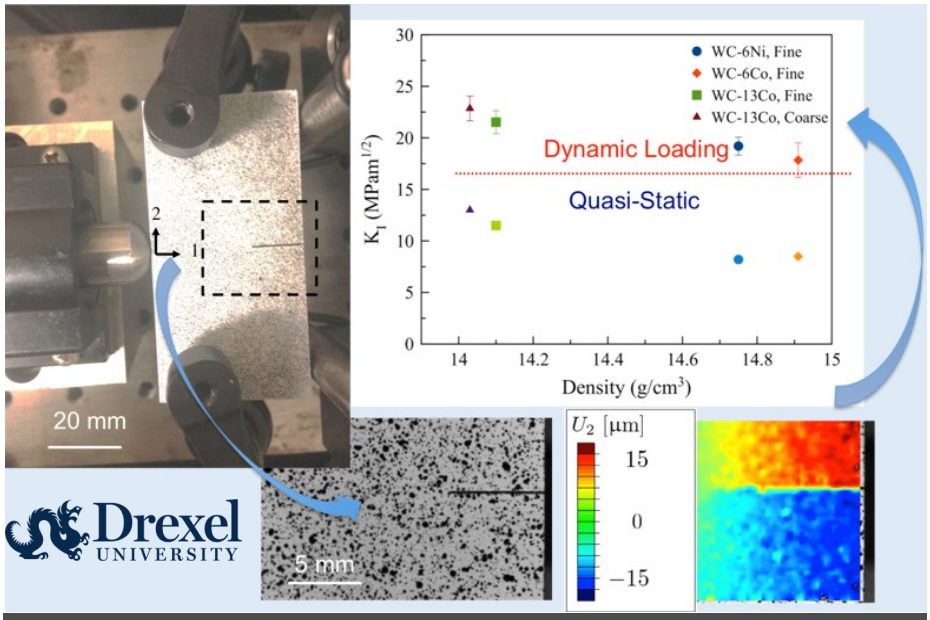
Features of the VFM plasticity module

The VFM plasticity module implemented in MatchID allows the fast identification of **yield criteria and multiple hardening laws**. It not only generates informative charts (stress space, parameter sensitivity, stress-strain curves,…) but also provides **full-field maps of the reconstructed stresses** at every load step. Finally, it allows the user to study the impact of DIC user settings as e.g. the virtual strain gauge on the final obtained mechanical properties (Fig.1) giving the module a thorough analysis character.

[1] The Virtual Fields Method, F. Pierron & M. Grediac, Springer 2012



A large Virtual Strain Gauge (VSG) will decrease the noise-floor of a DIC strain measurement. The reconstructed strain gradient value, however, will be lower and has a direct impact on e.g. the hardening coefficient (left panel) and the stress-strain relationship (right panel).



Crack propagation in dynamic loading scenarios measured with ultra high-speed imaging at Drexel University.

Application in the picture: Damage evolution under extreme strain-rates.

The Lamberson Research Group uses MatchID with **ultra high-speed imaging** to map material behavior under complex, dynamic loading scenarios. The team examines systems such as nanolayered MAX phases (metal-ceramic hybrids), ferroelectric ceramics, and hard metal tungsten carbides, to characterize damage evolution under moderate to extreme strain-rates. The group has specific expertise in extracting dynamic fatigue and fracture properties including anisotropic mixed-mode crack tip energetics from the resulting impact-driven displacement fields.

"MatchID 's unique features have ultimately saved us time and increased the quality of our results."

- Leslie Lamberson, Drexel University

One of the main challenges is the tradeoff between spatial and temporal resolution, a fundamental limitation of the cameras, with respect to the failure processes of interest. MatchID 's subpixel algorithms delivered **an improvement in capturing a growing crack front**, with higher order shape functions that minimize systematic errors, and reduce overall noise when dealing with colliding objects. In addition, using the performance analysis tool built directly into the software, **the ideal parameters such as virtual strain gauge size are easy to determine**, allowing us to optimize the data retrieved from limited pixels, while minimizing the amount of computing done in the process. These features, unique to MatchID, have ultimately saved us time and increased the quality of our results.

Dynamic Multifunctional Materials Lab, Drexel University, Philadelphia PA, USA
www.dynamic-lamberson.com

DIC course

Gent 2017, Belgium

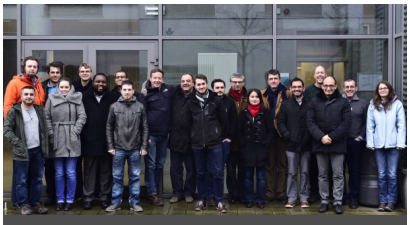
Thanks to very successful previous editions in Europe and America, an intensive 5-day course on deformation measurements using Digital Image Correlation is proposed here. The course is organized by three well-known international experts in the field with a broad experience in a wide range of applications: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

"This course provides true value for money"

- Participant 2016

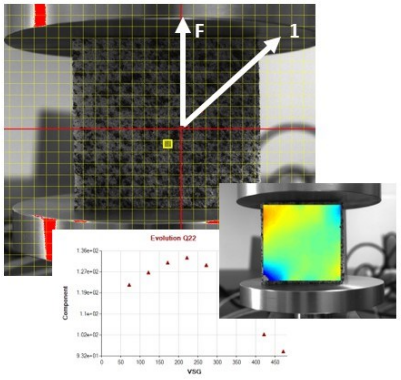
Specific focus is on the metrological aspects of the system, with quantitative interpretation of the results and errors. Theoretical lectures are alternated with in-depth experimental labs and data analysis. A maximum attendance of 20 participants will be respected in order to optimize interaction with 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://matchidmbc.com/diccourse



Participants DIC course 2016, Ghent

MatchID at SEM XIII, Orlando, FL, USA



MatchID 's first booth at SEM XIII, Orlando including a live demo on DIC & VFM.

The first MatchID booth was a great success with an interesting demo on orthotropic PVC foam identification by combining DIC and VFM. We would like to thank the more than 100 participants who visited our booth and invite all others to visit us in the future!

Next appointment: IDICs 2016 / SEM Fall Conference, Nov 7-10 2016, Philadelphia PA, USA, www.idics.org

Tip: Monday Nov 7 - Full Day course *General considerations in using DIC for material identification through VFM and FE model validation.* Dr. Lava (MatchID) and Dr. Rossi (University of Ancona)

Not just a DIC system …

- Interpretation of results in a quantitative way with **integrated error assessment**
- Detailed **validation of finite element simulations**: establish a one-to-one relation-ship between model and experiment by identical filtering
- **Identification of mechanical properties** via the Virtual Fields Methodology: (hyper)elasticity, plasticity, isotropic, orthotropic, …. Inverse identification made easy and fast.
- **Customized application development** and console mode to run batch pro-cessing
- In-depth training : annual courses by experts in the field, **self-training material**

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Contact Us

Give us a call or email for more information about our services and products

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Metrology beyond colors