Newsletter 2024/1

Ten years of MatchID!

Maybe we should join forces and integrate DIC with material identification and model validation? What started with a nice brainstorming session over Belgian beer resulted 10 years later in a stable and profitable international operating company, with a solid group of successful distributors, the establishment of two subsidiaries and a very loyal and technology driven customer base. Time flies, but the vision of MatchID has not dried up yet and our high-tech team will keep on surprising you in the upcoming years. Needless to say we are extremely proud of what has been achieved.

One of the cornerstones of the company has always been training. Improving knowledge creates eye openers for dedicated applications, enlarges the credibility of the technology and generates a very useful feedback synergy to improve our product portfolio. We have never renounced this fundamental basis, resulting in 10 editions of our annual intensive DIC course. Moreover, 2024 started with the planning of short editions of these in ETH Zurich, University of Bristol, San Francisco and ESB Edinburgh. A special thank you to Phil Reu for building the bricks, and Leslie Lamberson and Patricia Verleysen for hosting support!

We don't look back in regret to the second half of 2023: a very enjoyable iDICS event in Japan, combined with a range of inspiring visits and R&D discussions with a plethora of brand new customers. Thanks to our solutions for material identification for metal plasticity achieved via the European project VFORM-xSteels, we managed to rapidly establish a significant technological footprint in the land of the rising sun. A special thanks to our partners JSOL and TTS, and the support of Flanders Investment and Trade to facilitate this successful journey!

Commercially, 2024 so far took a firestart, and on top, you will be able to discover our exciting tools and meet the team at the control fair in Stuttgart and at a variety of conferences and expositions as announced on the last page. The cherry on the pie will be our first USA user meeting that will also allow to celebrate our anniversary. Keep an eye on your mailbox for further information!

Finally, a warm thank you to the team at the UK Atomic Energy Authority for sharing insights on how they adopt MatchID's levelling approach for model validation. Enjoy the read!

-The MatchID Team

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To celebrate MatchID's 10th year in business, we are organising the 2024 MatchID User Meeting. This will be held on June 2nd 2024, the preceding Sunday of the Society for Experimental Mechanics (SEM) Annual Conference in Washington. All MatchID users are warmly invited to participate.

MatchID 2024.1

What's new?

MatchID 2024.1 is out now! We are thrilled to present you the efforts of 6 months of work resulting into a set of versatile new features, amongst which:

Assisted driver installation and verification:

No more issues with wrong drivers. The proper device drivers are downloaded and installed automatically.

Live calibration and error assessment:

While grabbing calibration images you get an indication of regional epipolar errors hinting where to improve the calibration process by collecting more data.

Synchronized infrared high-speed imaging:

Support of Telops cameras and synchronization with white-light high-speed cameras.

### Improved FEA alignment tools:

Geometrical constraints make the alignment of FEA data and DIC images much more robust.

Image quality module for profound speckle analysis:

Quantitative metrics give you insights on the metrological performance of the local contrast.

VFM-identification of complex material laws based on multiple tests:

Identification based on multiple tests for enhanced parameter sensitivity. Now the door towards material testing 2.0 for anisotropic metal plasticity is fully open.
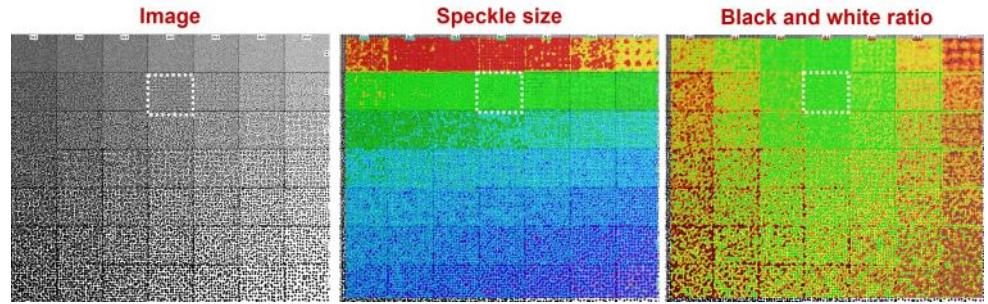
Validation of the module:
A grid of speckles with varying speckle size was created using the MatchID speckle generator. The image quality module was used to calculate the full-field maps of speckle size and black-to-white ratio. The module highlights that the speckle from row-2 column-4 is the most optimum for the current experimental setup. Note: green is better!
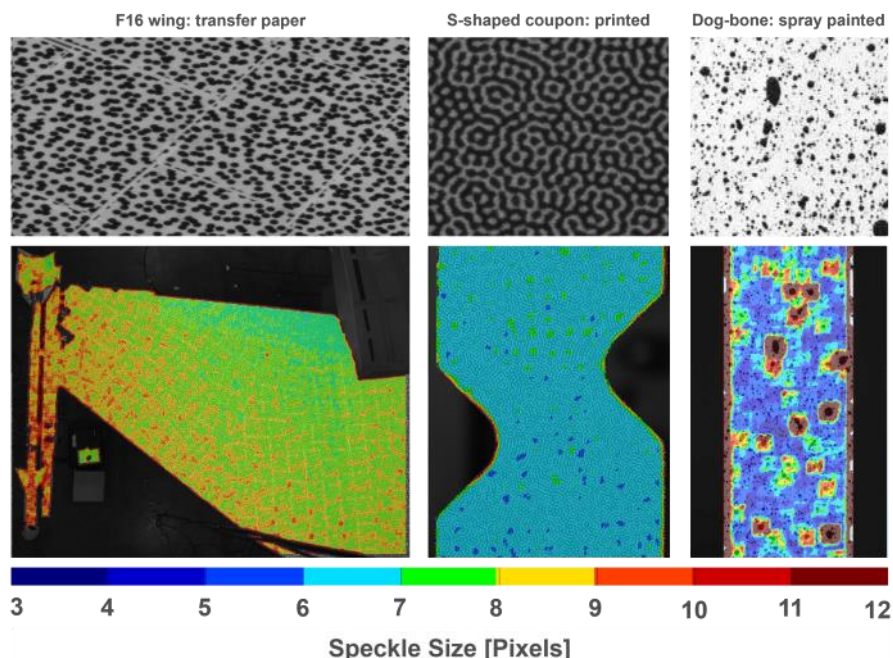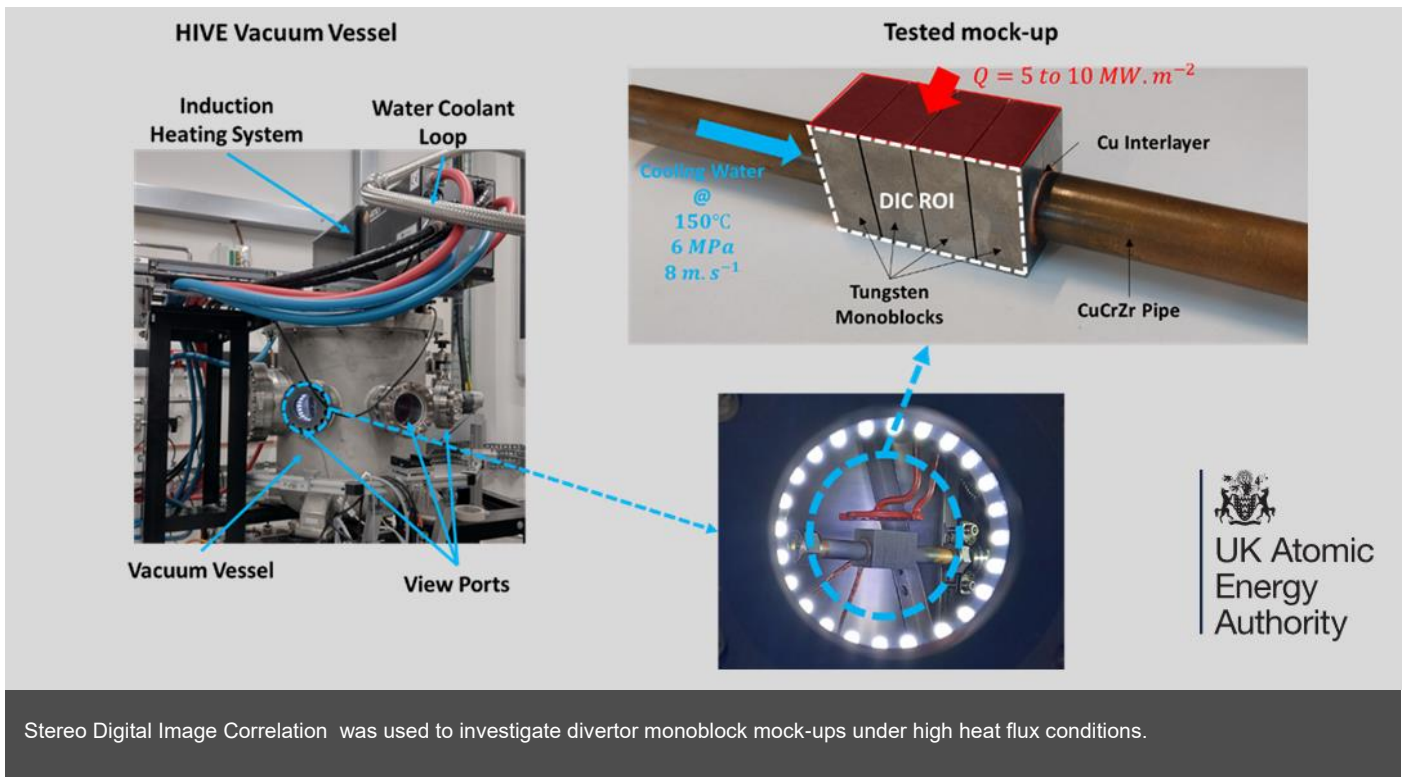
Image Quality Module

Highlights

✓ **Speckle size:** As recommended in the DIC Best Practices Guide, a speckle size of 3 to 5 pixels should be respected to maximize the DIC spatial resolution and avoid substantial interpolation bias and aliasing. Although this criterion should be respected over the entire DIC region of interest, usually in practice, a spatially averaged value is considered. The module offers **full-field speckle size visualization** capability allowing a more rigorous assessment.

✓ **Image-contrast:** High image-contrast is essential to minimize the DIC noise floor. **Black/white ratio maps** help the user ensure equal distribution of black and white regions in the speckle pattern. The module offers advanced **image-gradient-based full-field metrics** facilitating troubleshooting of local illumination and image-contrast problems.

The module can be invoked at the

→ **Preprocessing stage:** Coupled with *MatchID Speckle Generator* and *Virtual Setup Creation Tool*, this allows for a-priori design of an optimum speckle pattern.

→ **Experimentation stage:** Readily integrated within *MatchID Grabber*, allowing to efficiently optimize the DIC experimental setup choices such as illumination.

→ **Postprocessing stage:** Readily integrated within *MatchID 2D/Stereo*, allowing to investigate the problematic areas in the DIC region of interest.

The image quality module applied in various applications and how the speckling technique affects the local speckle size and accordingly the resulting DIC spatial resolution. It is clear that a well controlled and printed speckle pattern provides the best speckle size with least spatial variation.

Stereo Digital Image Correlation was used to investigate divertor monoblock mock-ups under high heat flux conditions.

Application in the picture: Full-field validation of a fusion divertor heatsink under high heat flux conditions.

We conducted a full-field experimental analysis of a fusion divertor heatsink under a steady-state, high heat flux loading of 5 to 10 MW/m^2. The component we tested is shown in the figure above. The heat flux was applied to the water-cooled sub-component using the Heating by Induction to Verify Extremes (HIVE) facility at UKAEA. We used Digital Image Correlation to measure the kinematic fields with temperatures on the top of the component of up to 1000°C. The tools in the MatchID grabber where used to help us setup our DIC system through the constrained view ports of the HIVE vacuum vessel. We selected converged parameters for our DIC post-processing using the MatchID performance analysis module applied to our experimental data and image deformation data produced using the FEDEF module. We then used the FEVAL module and its underlying levelling approach [1] to compare our DIC vertical displacement data to a finite element simulation of the component accounting for sources of uncertainty in our measurement chain as shown in the figure below. The levelling approach guarantees a true digital twin since it pushes the FEA data through the same filters as the connected DIC evaluation.

"MatchID's synthetic image deformation procedure is a key stone of our daily DIC practicing.

- Dr. A. Tayeb and Dr. L. Fletcher, UK Atomic Energy Authority
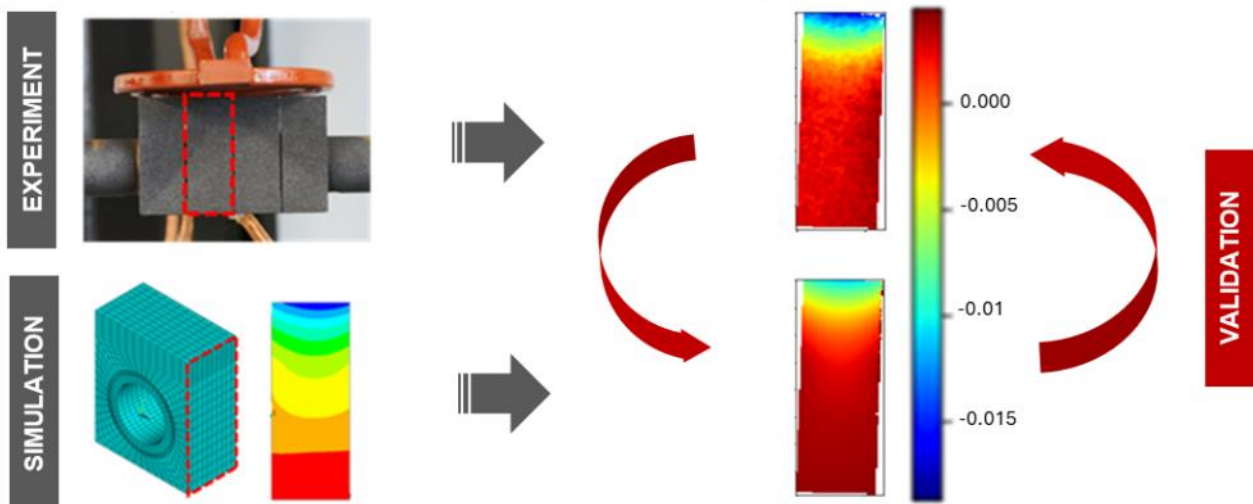
Investigator team: Dr. Adel Tayeb and Dr. Lloyd Fletcher (UK Atomic Energy Authority)
[1] P. Lava, E. Jones, L. Wittevrongel, F. Pierron (2020). Strain, 56(4)

Consulting services

Curious about what digital image correlation can do for your application? Our professional consulting services, established within Europe in collaboration with Mecatest, help you to figure out what you need before making any commitments.

Mecatest has extensive experience and expertise in using our turnkey solutions for various applications and industries. Within the US services are directly offered via our US office. Whether you are a beginner or an experienced user, we can help bring your skills to the next level.

We have a wealth of testing experience from real-world industrial projects. Our team will teach you the best practices and help avoid common pitfalls. We can also customize our solution to your needs. Contact us to learn more!

DIC Course

Last February, we were pleased to host 20 participants from all over the world at our 10th intensive 5-day course on DIC. As always, discussions with students where very inspiring. On top, we recorded all the theory sessions. As a MatchID customer, you can continuously rewatch these on our wiki-pages. More than 10 hours of DIC lecture food! Furthermore, we will be organizing two short courses on DIC, one at the ESB conference in Edinburgh and a second one in California, US. Feel free to join!

Meet MatchID at:

- ***Demo sessions:*** *A demo video followed by a live Q&A session to improve your MatchID product knowledge:*

  ⇒ 10/04/2024 Demo 1 - An introduction to the MatchID hardware

- ***Webinars:*** *a 45 min-journey to a specific MatchID product illustrating its capacities towards a large range of applications*

  ⇒ 22/05/2024 Webinar 1 - Digital Twin in DIC for model validation and material identification

- ***Conferences and expositions:***

  ⇒ CONTROL Fair Stuttgart, Germany - 23/04/2024
  ⇒ ESAFORM Toulouse, France - 24/04/2024
  ⇒ ASME Seattle, US - 29/04/2024
  ⇒ SEM Vancouver, US - 3/06/2024
  ⇒ ESB, Edinburgh, UK - 30/06/2024

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