MatchID
Metrology beyond colors

September 2024

Newsletter 2024/2

Better, faster, stronger!

Hello again and thanks for checking in to get some exciting updates from MatchID. Buckle up because we have a plethora of things to announce this time. First of all, the past few months were quite intense in view of knowledge distribution and product advertising. A growing team comes with several advantages, and one of them is that we are now fully equipped to have a physical presence at simultaneously occurring events. Hence, we were very proud to have a first time showcase of our integrated solution via our brand-new booth at the Control Fair in Stuttgart, while concurrently sending an R&D delegation to Esaform in Toulouse to maintain our loyal partnership with this inspiring community. Accordingly, a sustainable growth can be pursued in both academica and industry, while also keeping track of the latest technological evolutions, which is crucial in the market we are operating in.

Secondly, it is very rewarding to witness that one year after the setup of MatchID US, the efforts are already paying off. Isabella managed to add a substantial amount of respected US companies and universities to our customer portfolio, well-done! It is also great to see that these two entities of MatchID are very interactively entangled. Indeed, a US tour was organized last June, encompassing business and marketing discussions, (potential) customer visits, an updated DIC short course, … with the cherry on the pie: the celebration of ten years of MatchID at SEM in Vancouver as a main sponsor. On top of that, the updated short course got recorded and is now consultable at our dedicated wiki-pages. Learn to improve!

In the meantime, the development carousel never stops turning at MatchID. In the course of creating a dedicated fracture module that needs to cope with dense point clouds, we revisited our fundamental DIC implementations. A considerable speed gain was achieved while preserving metrological performance. This new solution makes us one of the most performant DIC packages on the market. Moreover, this fracture module will be a keystone of our next release MatchID 2025: by integrating our stress reconstruction algorithms with J-integral formulations, one will be able to determine the crack-tip location with maximum accuracy. Update your support contract today or download a free trial to exploit these new features!

Finally, a warm thank you to the team of Ecole Centrale de Lyon for sharing a very nice application of the MatchID FEA validation strategy on arteries. It is nice to see our philosophy entering in the biomedical world!

-The MatchID Team

In this issue

The brand-new MatchID booth, showcased for the first time at the Control Fair in Stuttgart.

MatchID 2024.2

What's new?

MatchID 2024.2 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:

New innovative DIC algorithm:

Up to 10 times faster, with the same metrological performance.

Enhanced Performance Analysis module:

On the spot point extraction over multiple files. Sigma lines materialising noise thresholds.

Integration of Baumer and NAC cameras:

These cameras are added in our quasi-static and high-speed grabbers with all advanced functionalities.

Automated crack path extraction:

A strain-based threshold approach leads to a seamless extraction of the crack path.

Forming Limit Curves and Diagrams:

A new module allowing to display fracture quantities in sheet metal forming.

FEA Integration with LSDyna and Nastran MSC/NX:

Our levelling approach for FEA model validation has been extended with a seamless communication line with LSDyna and Nastran MSC/NX.

Enriched Noise Evaluation module:

Evaluate both spatial and temporal noise of your cameras.

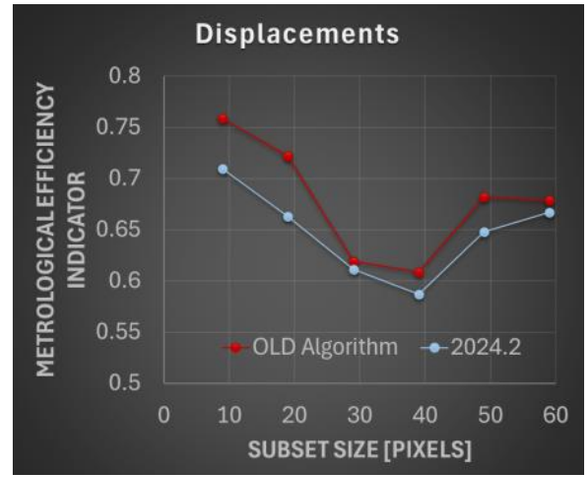
Faster innovative DIC algorithm

Why and how?

MatchID's DIC algorithms have always been fast, but our key focus has always been on accuracy and precision rather than on pure computational performance. Continuously increasing camera spatial resolutions and a growing amount of applications where the DIC step size needs to be small (*e.g.* crack detection, measuring close to edges, defect and strain concentrations, ...) forced us to rethink our fundamental implementations. Indeed, with the advent of millions of datapoints to process, computational speed becomes a crucial component. A persistent prerequisite, however, was not to compromise on the accuracy and precision of the methodology. Fortunately, MatchID has a profound experience in **both local and global DIC** solutions. A **mixture** of these two principles appeared to be crucial in paving the way towards an innovative solution that can deal with the computational demands of dense DIC datasets!

Accuracy and precision validation

As indicated above, a central objective of the new algorithm 2024.2 was to guarantee the same metrological performance as before. To this purpose, algorithm 2024.2 was subject to the star pattern image sets from the DIC challenge 2.0 [1]. These synthetic star images encode a spatially-varying-frequency sine-wave in the y direction with a constantly increasing frequency in the x-direction and a ±0.5-pixel displacement amplitude. These images were processed with a varying range of subset sizes and the generated displacement results were then independently evaluated by Prof. Benoit Blaysat at Clermont -Auvergne University in France, via the metrological efficiency indicator defined in [2]. This indicator accounts for both spatial and displacement resolution, with a smaller number indicating better metrological performance. The graph displays the results of both 2024.2 and the old algorithm. As can be inferred, the new algorithm even slightly outperforms the old one because of the regularization capacities of embedded global principles.

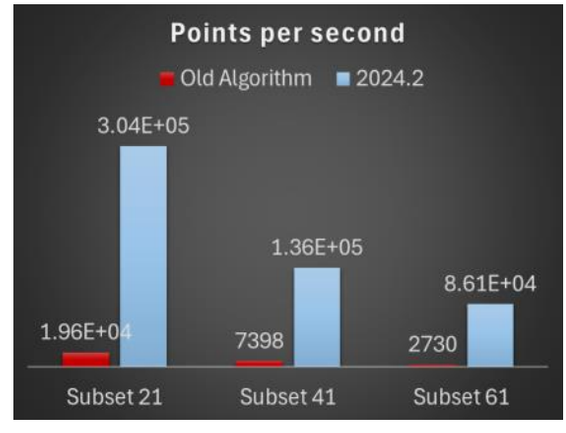


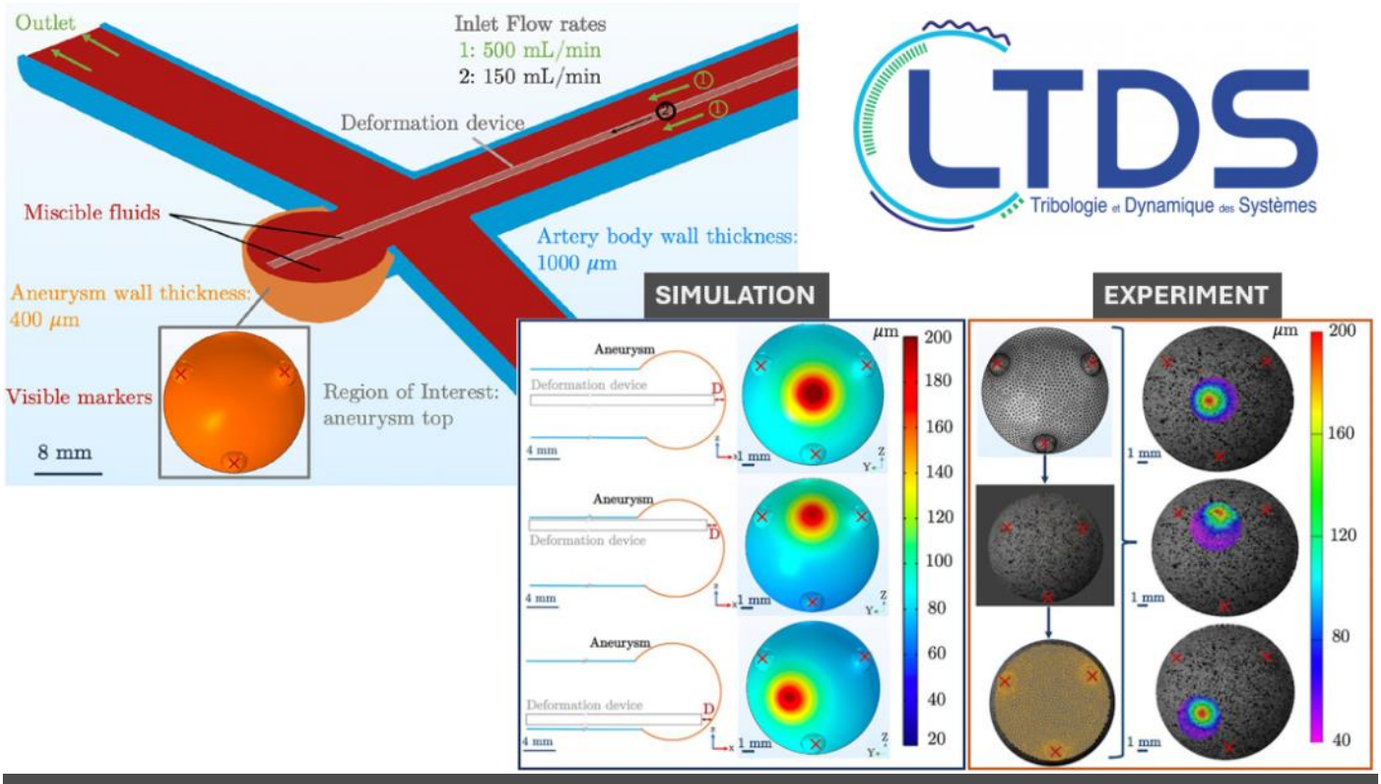
[1] P. Reu et al., *DIC Challenge 2.0: Developing Images and Guidelines for Evaluating Accuracy and Resolution of 2D Analyses*, Exp Mech 62, 639–654 (2022).

[2] Blaysat, B. et al., *Towards Criteria Characterizing the Metrological Performance of Full-field Measurement Techniques*, Exp Mech 60(3), 393-407 (2020).

Computational performance valuation

Confident about the metrological performance, one can now embark on the computational efficiency of the algorithm. To that aspect, a 16 MPx image has been analyzed on a laptop (AMD Ryzen 7 5800U with Radeon Graphics, 1.90 GHz 8 cores). Varying subset sizes have been imposed but the step size was fixed to 1 and quadratic shape functions were enforced, generating over 7M datapoints per subset analyse. As can be inferred from the chart, the novel algorithm delivers a considerable computational gain that even grows with increased subset sizes! This new solution makes us one of the most performant DIC packages on the market, both computationally and metrologically.





At Ecole Centrale de Lyon, Stereo Digital Image Correlation was used to investigate the interaction between the deformation device prototype and the phantom aneurysm wall. The upper-left image shows a schematic layout of this interaction. The lower-right directly compares the displacement norm Experimental and simulation results at three different locations of the deformation device.

Application in the picture: FEA-DIC validation applied to an aneurysm mechanical characterization device

Intracranial aneurysm is a pathology related to the biomechanical deterioration of the arterial wall. As yet, there is no method capable of predicting rupture risk based on quantitative, *in vivo* mechanical data. Researchers at the Ecole Centrale de Lyon aim at providing clinicians with a non-invasive, patient-specific decision support tool, based on the *in vivo* mechanical characterization of the aneurysm wall. To this end, an original *in vitro* arterial wall deformation device was developed and tested on polymeric phantom arteries [1]. Hereby, the deformation induced by the device on the polymeric phantom arteries was measured by the MatchID system. The phantom arteries tested in this study were manufactured using injection molding (IM) and stereolithography (SLA) 3D printing techniques. In the figure above, the upper-left image shows a simplified Y-shape of an IM phantom artery.

> *"The FEVAL module and COMSOL Multiphysics allowed a successful comparison of FEA and DIC results on aneurysm phantoms."*
>
> *- J. Raviol and G. Plet, Ecole Centrale de Lyon*

Concurrently, a computational model coupled with the experimental study was developed to improve understanding of the interaction between the arterial wall deformation device and the aneurysm wall. In the framework of this study, the researchers have adapted MatchID's levelling approach [2] via the FEDEF and FEVAL modules towards COMSOL Multiphysics, allowing for a quantitative comparison of computed and measured strains. In order to align the frames, spherical excrescence markers were obtained by mold milling in the area targeted to ensure visibility and feasibility.

This procedure was then used to obtain valuable insights and explore scientific challenges that the experimental study has yet to address. As can be inferred from the figure above, comparisons have been established at the central, top and bottom part of the aneurysm. The influence of the local thickness on the aneurysm and the Deformation Device Prototype (DDP) locations were studied. Furthermore, the complexity of the experimental study could be increased by investigating more complex and patient-specific artery shapes or adding heterogeneity to the arterial wall. This both digital and experimental investigation of the DDP was an essential step prior to *in vivo* animals testing.

[1] J. Raviol, G. Plet, H. Magoariec, C. Pailler-Matteri. *Numerical modelling of an aneurysm mechanical characterization device: Validation procedure based on FEA-DIC comparisons,* Exp Mech 64, 625-638 (2024).

[2] [2] P. Lava, *et al. Validation of finite-element models using full-field experimental data: Levelling finite-element analysis data through a digital image correlation engine*, Strain 56,12350 (2020).

New Japanese distributor

We recently hosted representatives from Tokyo Boeki Techno System Ltd. (TTS) at our headquarters for the official signing of a new distributor agreement for Japan. TTS is a highly respected integrator of optical and scanning measurement systems, with a strong track record of delivering innovative solutions. This collaboration goes beyond just business; it represents a true synergy in development, combining our expertise with their extensive market knowledge and technical capabilities. Together, we aim to enhance the reach and impact of our offerings in Japan. A fruitful and longstanding cooperation is born!

Short course material

Last June, we hit the road for a U.S. tour that brought our headquarters and U.S. office together for some valuable face-to-face time. The trip was packed with business and marketing discussions, visits to (potential) customers, and an updated DIC short course that we hosted in California with many participants joining us online as well. We're excited to share that the online version of the short course was recorded and is now available on our wiki-pages. These "Introduction Lectures" are perfect for getting a solid understanding of DIC basics, covering how we at MatchID handle correlation procedures and uncertainties. The course is split into four parts: 2D DIC, Uncertainty Quantification, Stereo DIC and Digital Twin. If you're looking to dive deeper, don't forget to check out our detailed DIC course lectures. And to top it all off, we celebrated ten years of MatchID at the SEM conference in Vancouver, proud of being one of the main sponsors.

Meet MatchID at:

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

  ⇒ 09/10/2024 Demo 2 - Unravel novel features in the MatchID grabber

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

  ⇒ 11/12/2024 Webinar 2 - Integrated facture mechanics in MatchID: from automated crack path detection to J-Integral calculation

- ***Conferences and expositions:***

  ⇒ BSSM Conference - EMex24 Liverpool, United Kingdom - 03/09/2024
  ⇒ Aerospace Test and Development Show Toulouse, France - 10/09/2024
  ⇒ IDICS Clermont-Ferrand, France - 29/10/2024
  ⇒ NAFEMS Senlis, France - 19/11/2024

Contact Us

MatchID
Leiekaai 25A
B-9000 Gent
Belgium

info@matchid.eu

+32 223 64 41

www.matchid.eu
www.matchid.us
www.matchid.co.uk

Partners

China: ltydic.com

Japan: tbts.co.jp

France: mecatest.com

South Africa: hornetechnologies.co.za

Australia adept.net.au

Poland: invenco.pl

India: HighTechEng Equipments

MatchID
Leiekaai 25A
B-9000 Gent
Belgium

MatchID
Metrology beyond colors