MetroCT

Developing advanced image reconstruction algorithms for industrial X-ray CT scanners

Today, X-ray computed tomography (X-ray CT) is mainly known for its medical imaging applications in hospitals. Yet, the technology also has tremendous potential in industrial settings, where it can be used to study the properties of materials in a non-destructive way. That allows companies to increase their knowledge of the materials they are working with and to use those insights to improve their R&D, industrial inspection and quality control efforts.

But for demanding industrial applications, today's CT image reconstruction algorithms do not deliver the required image quality. That is why MetroCT investigated the development of advanced algorithms to support higher quality (and even dynamic) image reconstruction of materials such as diamonds, metal objects and materials that deform under stress (e.g. foam).

"MetroCT has been a highly demand-driven research project," explains Jan De Beenhouwer (iMinds - University of Antwerp) who coordinated the project's research effort. "Diamcad, a partner active in the diamond sector, wanted to leverage CT technology to achieve better accuracy in the detailed study of rough stones and the actual polishing of diamonds. Huntsman, a global manufacturer of chemicals, was looking for a more thorough understanding of PU foam's behavior when being subjected to pressure; an analysis that industrial CT scans currently cannot accommodate. Finally, 3D metal printing company Melotte wanted to investigate CT scanning technology that can properly deal with metal objects."

"And then there was the time constraint," adds Jelle Vlassenbroeck (Inside Matters) who took the overall lead for the MetroCT project. "As time is money, the duration of CT scans needs to be limited – especially in 3D environments in which more data are required to accurately reconstruct an object's image."

THE OUTCOMES

1. Making CT image scanning 5 to 10 times faster than today's state-of-the-art

One major MetroCT breakthrough has been the development of advanced algorithms that require 5 to 10 times less data (fewer viewing angles) to accurately reconstruct an object's image. As a result, the algorithms proposed by the MetroCT team make X-ray CT imaging 5 to 10 times faster than today's state-of-the-art.

2. Algorithms that predict 10 times more accurately how a diamond should be polished

MetroCT has resulted in unique algorithms that accommodate a complete, high-precision scan of rough diamonds and that result in an accurate 3D model of the stone. Building on that input, specialists can navigate through the individual constraints of the rough stone, and then leverage the algorithm to optimize the quantity and quality of the simulated outcome. Thanks to the MetroCT technology, the optimal polishing of Diamcad's stones can now be guided by X-ray CT technology 10 times more accurately.

3. Dynamic algorithms for an industrial setting

Today, using scanning technology to analyze the behavior of complex materials during a deformation (e.g. PU foam that is being subjected to pressure) is a slow process that requires a lot of computing power while still missing out on valuable information. MetroCT has taken a big leap forward in this domain by developing advanced algorithms that can more rapidly quantify and interpret these dynamics in an industrial setting. As such, experts can more easily draw conclusions and come to completely new insights on the behavior of these complex materials.

NEXT STEPS

Consortium partner Diamcad is working on integrating the advances brought by the MetroCT project in its daily operations, i.e. the detailed study of rough stones and the accurate polishing of diamonds. Thanks to MetroCT, Diamcad's scanning methods can now take into account the exterior as well as the interior of a stone in a single step. This enables the Diamcad specialists to better analyze the rough diamond and all its imperfections, in their continuous strive to get the highest value out of it. As Diamcad is probably the only company in the world that possesses this improved scanning technology, it has an important competitive advantage to attract new business to its Antwerp offices. As a next step, the initiation of a follow-up research track with scientists from iMinds - University of Antwerp is being investigated.

Industrial partner Huntsman acquired important insights on the use of X-ray CT technology and how some of the hardware limitations they originally got confronted with can be overcome by means of advanced algorithms. Encouraged by the MetroCT advances and the potential of X-ray CT technology for their business, Huntsman acquired a CT scanner during the project to further explore this potential. Just like Diamcad, Huntsman is looking into possible follow-up research with iMinds scientists.

"Offering industrial CT as a service to customers that are active in a wide range of domains – from medical devices, to food and crops, and even the construction industry – we are highly interested in extending the three MetroCT use-cases, and the underlying algorithms, to any other application domain that could benefit from this technology. Also there, more work is required – and we're currently investigating how to tackle this opportunity," concludes Jelle Vlassenbroeck (Inside Matters).

FACTS

NAME	**MetroCT**
OBJECTIVE	Developing advanced image reconstruction algorithms for industrial X-ray CT scanners
TECHNOLOGIES USED	Micro-CT scanners, 3D image reconstruction software
TYPE	ICON project
DURATION	01/01/2014 – 31/03/2016
PROJECT LEAD	Jelle Vlassenbroeck, Inside Matters
RESEARCH LEAD	Jan De Beenhouwer, iMinds - Visionlab - UAntwerpen
BUDGET	1,690,000 euro
PROJECT PARTNERS	Diamcad, Huntsman, Inside Matters, Melotte
RESEARCH PARTNER	Centrum Wiskunde en Informatica
IMINDS RESEARCH GROUPS	IBiTech - UGent Visionlab - UAntwerpen

WHAT IS AN

ICON PROJECT?

iMinds is the digital research center and business incubator for Flanders, Belgium. Its ICON research projects are agile and demand-driven, combining academia and industry partners. ICON projects typically have a duration of two years, yet quickly adapt to the rapidly-evolving digital landscape. ICON partners intend to use the project results in their products or services.

MetroCT project partners:

diamcad ADDING ANOTHER DIMENSION

Melotte

HUNTSMAN Enriching lives through innovation

INSIDE MATTERS INSIGHTS TO INNOVATE

AGENTSCHAP INNOVEREN & ONDERNEMEN Vlaanderen is ondernemen

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