

Doctoral candidate 10: Sensory-based and prior knowledge exploitation in 4DCT

Host Institution	Tescan XRE
PhD enrolment	University of Antwerp
Primary Supervisor	Dr. Arjen Mascini
Subject area	Dynamic 3D X-ray CT, sensors, prior-knowledge

About this doctoral project and your tasks

3D X-ray CT scanning is a very powerful technique to investigate the internal structure of objects without the need to cut them open and is frequently being used in research and industry for material investigation and quality control. While being very powerful, traditionally such scans only result in one static 3D result. New developments allow to extend the 3D results in function of time (4DCT) by acquiring multiple scans over time, opening new possibilities to now also dynamically investigate objects while being subjected to deformation under influence of forces or temperature. Many efforts are being undertaken to perform such dynamic experiments as fast as possible, the limitations in speed are often related to noisy results from such fast experiments.

You will focus on the exploitation of prior-knowledge resulting from (long) high quality acquisitions and additional sensory data to improve both time and spatial resolution of 4DCT acquisition and reconstruction. Specifically, you will tackle the challenge of lifting 4DCT from pre-defined, static acquisition parameters to real-time adaptation. The possibilities of such an approach have so far only been demonstrated on mostly theoretical data. The in situ experimental implementation offers a series of challenges for which different approaches will be investigated. Signal information from the actuating process or from an additional sensor will be used for real time modification of the acquisition in terms of speed and/or contrast. Similarly, the resolution can also be improved if the location of interest can be identified to zoom in towards the ROI. The challenges for this are both in the identification of the region and the dynamic steering towards that region. The identification consists of using innovative algorithms that include specific prior knowledge (e.g., high quality pre-scan, shape model, CAD data).

Your tasks will include :

- Implement workflow strategies and protocols for accelerated 4DCT based on prior-knowledge of smart materials with a demonstrated gain in speed at the same SNR compared to the current state-of-the-art
- 4DCT with dynamic adaptation of the acquisition parameters, triggered and steered by sensory data or comparison with prior knowledge data

Foreseen secondments

For this project, we foresee secondments to:

- Prof. Dr. J. De Beenhouwer (4 months) at University of Antwerp (Belgium)
- Dr. D. Vavrik (4 months) at The Institute of Theoretical and Applied Mechanics of the Czech Academy of Sciences (The Czech Republic)