Geometric calibration of a radiological NDT system

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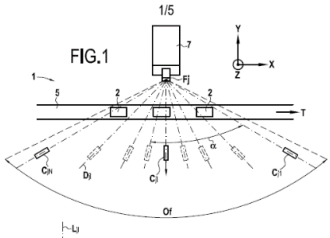

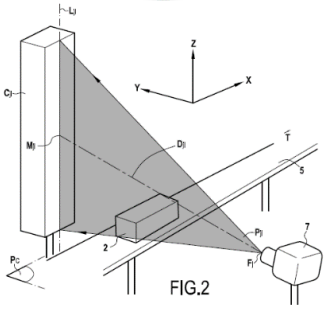

Contexte. A set of linear X-ray detectors is designed for NDT (Non-Destructive Testing) on a production line. The controlled object is moving along the production line. It is radiographed by all the detectors. From the collected measurements, the object is reconstructed in 3D. In order to be able to reconstruct the object from the collected radiological data, it is necessary to know precisely the acquisition geometry of the system, i. e. the position and orientation of each linear sensor as well as the position of the source in a reference frame associated with the production chain [2].

Keywords: tomography, identification, computer vision

Obectives. The objective of this project is to geometrically calibrate the measuring system composed of an X-ray source and a set of linear sensors. To do this, we consider three approaches:

1. The design of a 3D test pattern composed of radio-opaque elements allowing the global system to be geometrically calibrated[2]. The difficulty here is to calibrate at the same time the fan beam geometry of each linear detector in the plane it forms with the source as well as the relative positions of these planes in 3D.
2. The design of a 3D test pattern composed of radio-opaque elements (for example, a set of 3D balls) that will be set in motion in front of the detectors. We will show that this approach can lead to classical calibration methods, cf. [2], of a set of two-dimensional linogram-parallel 3D projections.
3. The design of self-calibration methods for such a measurement system based on radiological projections of an *unknown* object, in scrolling mode as in 2. or fixed mode as in 1.: such a self-calibration approach will be studied and, possibly, associated numerical methods proposed. [1,3]

This research work in computer science and mathematics will be carried out in close collaboration with the company developing the NDT system. In particular, data may be acquired on a test bench for the evaluation of the proposed calibration methods**.**

Practical information. The duration of this PFE or Master project is 6 months. A continuation in a thesis or engineering contract in the company is possible. The project will be carried out in close collaboration between the TIMC laboratory (Grenoble) under the supervision of Laurent Desbat (laurent.desbat@univ-grenoble-alples.fr) and the TIAMA company developing the NDT system in the Lyon suburbs. Skills in mathematical modelling, identification and computer vision are required for this project.

References.

[1] R. Clackdoyle and L. Desbat. Full data consistency conditions for cone-beam projections with sources on a plane. Physics in Medicine and Biology 58.23 (2013), p. 8437.
[2] R. Hartley and A. Zisserman. Multiple View Geometry in Computer Vision. Second Edition. Cambridge University Press (2000)
[3] J. Lesaint, S. Rit, R. Clackdoyle, and L. Desbat. Calibration for Circular Cone-Beam CT Based on Consistency Conditions. IEEE Transactions on Radiation and Plasma Medical Sciences (2017) pp. 517–526.