Spectral Radiography and tomography for materials identification

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The development of X-ray detectors along with fast electronics and signal processing in recent years allows to get real time spectral images in transmission, i.e., in a single acquisition, images at several energy bins. Thus, the identification of materials categories (typically “heavy” versus “light”) which was done in dual energy techniques can be extended to the discrimination of several materials with a better sensitivity. This presentation comes from a collaboration between National Institute of Applied Sciences of Lyon (INSA Lyon) and Shenzhen Institutes of Advanced Technology (SIAT), combining simulations and experiments. The simulation software Virtual X-ray Imaging (VXI) developed by INSA-Lyon has been used to simulate different practical industrial or medical cases in order to develop a material decomposition algorithm. Depending on the application (such as plastics sorting, or identification of minerals of medical interest), we have shown in previous work that the decomposition algorithm can be improved by a classification step to enhance the separation of materials which are close in attenuation. The simulation considers a direct conversion cadmium telluride (CdTe) detector whose response is modeled by its absorption factor, in order to see the influence of acquisition parameters on the results, in particular the compromise between the amount of noise and the number of energy bins used. However, when coming to a real detector, several effects such as charge sharing tend to influence the signal received, and those effects are not taken into account in the simulation. For this reason, a calibration is necessary in order that the decomposition method can work with experimental measurements. Such a calibration consists in measuring the attenuation coefficients for a range of known materials of fixed thickness, using a spectral detector with a high number of energy bins. A very first result was shown at DIR2019. Thanks to the collaboration with SIAT, new measurements have been carried out and will be presented here.