Contribution ID: **182** Type: **Poster**

P2.32: X-ray computed tomography of the periodically moving object

Wednesday, 28 June 2023 17:12 (1 minute)

X-ray computed tomography is now a common method of non-destructive testing of a wide range of static objects. In recent years, time-dependent tomography has been on the rise, for which it is necessary to record a series of tomographic data covering the event of interest. For slower events, conventional laboratory CT scanners can be used, while when events are faster, a very intense X-ray source is usually required. For high resolution requirements, the need for an intense X-ray source leads to the use of a synchrotron. This is because it is clear that in the case of an insufficiently intense X-ray source, the statistics in a single X-ray image are too low and a high quality tomographic reconstruction cannot be achieved. An exception is tomographic tracking of periodic events. As will be shown, for these, a good quality reconstruction can be achieved even in the case of a relatively low-intensity X-ray source. A crucial condition is the precise synchronization of all components of the system. While sufficient statistics in a single projection is achieved by integrating very short images acquired at an identical position of the moving object. In all cases, it is necessary to have an imaging detector with a sufficiently high frame rate, accurate synchronization via a common trigger signal and the possibility of very short exposure times.

Tomography of a periodically moving sample with a frequency of 4 Hz and an amplitude of 2.5 mm was performed using a Dexela 1512NDT detector. The resulting tomographic reconstruction has almost the same quality as in the case of tomography of a static object. The Dexela detector with 2x2 binning has a minimum exposure time of 25 ms, using external HW triggering. As an alternative, a 2x5 MPX3 detector with a sensor thickness of 500 mm was tested, which has excellent temporal resolution and thus allows tomography at higher frequencies.

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Session Classification: Poster (incl. coffee)