Portable Multi-Robot Computed Tomography scanner for NDT of Large and Complex Parts (RadalyX)

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Computed tomography (CT) is an established nondestructive testing (NDT) method that reveals volumetric information of internal and external structures of the inspected part. CT scans inspect a wide range of sample sizes, shapes, and defects at different spatial resolutions. However, CT scanners require placement of inspected parts inside a scan chamber of a limited size. Transport of complex and large inspected objects to the CT scanner is yet another challenge. Maximum overall size of the inspected object is thus often the major limit of CT scanners' applicability. Moreover, CT inspection of region of interest (ROI) of large structures, such as aircraft control surfaces, may require components disassembly, transportation, or even destructive cuts. Therefore, scanner portability widens the applications range of CT by bringing the scanner to the inspected part and not the other way around. In this abstract we present a portable multi-robot imaging platform, referred to as RadalyX, with full capabilities of CT (computed tomography) inspection. RadalyX is equipped with two 6-joint robotic arms that can position the detector and the X-ray tube independently and freely around scanned objects. Depending on the sample size and the shape, the robots perform the pre-programmed movements capturing X-ray projections that are subsequently processed to 2D or 3D images. The flexibility of positioning enables new types of scanning trajectories at multiple angles ("arbitrary path CT"). RadalyX performs CT and tomosynthesis scans as well as conventional 2D radiographic scans with precisely calibrated and repeatable geometrical accuracy leading to a spatial resolution of up to 60 µm. The machine overcomes the limitations of conventional CT systems by using the photon counting detector with benefits in terms of resolution, sensitivity, dynamic range, noise reduction and spectral imaging. RadalyX allows integration of multiple scanning robots into several stand-alone and movable stations. The stations can be positioned arbitrarily in the field and geometrically calibrated to enable scanning modes such as X-ray transmission or even a single sided approach, e.g., X-ray back-scattering. On the other hand, the possibility of integration into production lines enables regular NDT inspections. In addition, RadalyX is extendable by other imaging modalities, such as laser profiling and laser-excited ultrasound providing complementary inspection capabilities in different kinds of materials. RadalyX is improving the applicability of imaging methods to a wider range of test objects and fields where the inspection was not feasible or was only limited and introduces NDT applications of different robotic X-ray scan trajectories. Such trajectories range from planar and parallel 2D scans, arbitrary path CT, and tomosynthesis to recently developed X-ray backscattering.