Manual Inspection or R2-D2: Quo vadis NDT?

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As with many other areas of technology, nondestructive testing is currently undergoing a shift towards a higher level of automation. This includes not only the trend towards the use of more robotics, but also the entire signal processing chain, imaging and characterization algorithms, and the final interpretation to evaluate the actual component condition. Both the omnipresent cost pressure in quality assurance and the shortage of qualified inspectors in many industries support the trend towards machine-based inspection processes. The current rapid progress in the field of artificial intelligence will additionally massively accelerate this change. As an example, the presentation will show a fully automated and flexibly positionable NDT dual robot platform that can inspect components with a size of up to 12 m². Integrated tool changers enable the use of several simultaneous or serial inspection processes. In order to operate a variety of different NDT processes, the individual robots are laser calibrated and achieve a path accuracy of approximately 100 µm. The robots are mounted on freely movable platforms and can be moved on air cushions despite their weight of over 4 tons. The required registration of the two NDT tool centers into the laboratory coordinate system is therefore performed by an additionally operating laser system. The possibilities and limitations of machine automation are illustrated using the example of air-coupled ultrasonic testing. In addition to automated hardware, it will also be shown how complex data sets can be automatically evaluated to determine material parameters in composites such as fiber lengths and orientations or pore contents. This includes the use of nonlinear UT to test adhesive bonds for kissing bonds. One of the key challenges of non-destructive testing is the transfer of test data into a true picture of the component's condition. Usually, this requires solving a classical inverse problem. While numerous solvers exist for CT, methods such as thermography are only at the beginning of the development of complete inverse 3D solutions. Using the example of active thermography, we show how precise defect geometries and defect depths can be represented by means of AI, thus achieving a significantly increased informative value compared to conventional readout algorithms. The presentation also will discuss the competition of AI-approaches with hardware based physical NDT solutions.