Ultrasonic Computed Tomography of Large Rotor Forgings - Experience during Series Production Ultrasonic Testing using Quantitative SAFT

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Large rotor forgings, which are usually one of the most critical components in land-based turbines and generators for power generation, require extensive volumetric testing to ensure a sufficient service life. This is usually accomplished manually or automatically using ultrasonic testing. New requirements, designs and materials make more sensitive testing necessary. This can be achieved using the Synthetic Aperture Focusing Technique (SAFT), also known as ultrasound computed tomography. SAFT is based on Synthetic Aperture Radar (SAR) and has been developed over the past decades by several universities and uses analytics (i.e. a mathematical algorithm) to reconstruct the volume. This does not only allow to display indications spatially and visually correct in the 3D volume, but also improves the signal to noise ratio significantly, allowing an increase of sensitivity by up to an order of magnitude. The introduction of SAFT into the series production of large forged parts was made possible by the introduction of the Quantitative SAFT (QSAFT), also called AVG SAFT or DGS SAFT, which allows the evaluation of each voxel in units of a reference reflector, and by an acceleration which allows the reconstruction of the complete volume of a large forgings. This publication shows the working principle of the method along with the experience gained during the introduction of SAFT testing in series production. It shows how SAFT displays information, how the detection limit can be determined for quantitative SAFT, and which artifacts can occur during series testing with SAFT. Concluding, the benefit and challenges for fracture mechanics are discussed along with the challenges for inspectors. QSAFT was awarded by the Werner von Siemens Award as one of the Top 15 ingenuity programs in 2016 and by the German Society for Non-Destructive Testing (DGZfP) with the application award in 2019.