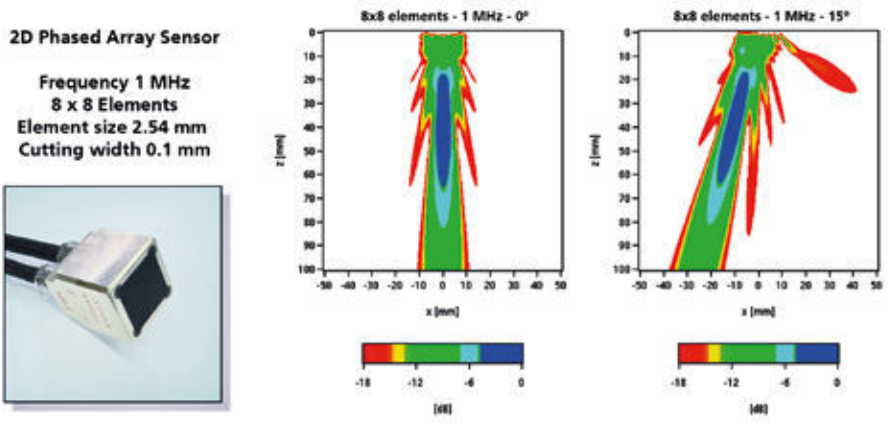
PERVASIVE ACTION

Nondestructive inspection of complex components and assemblies

Ultrasonic inspection of components and assemblies made of carbon fiber reinforced polymer (CFRP) is subject to special challenges due to material properties and complex component geometries. In order to optimize these inspections the simulation models which are used to adapt the ultrasonic inspections to relevant application parameters have to be modified and optimized accordingly. Saarbrücken based Fraunhofer Institute for Nondestructive Testing IZFP did just that.



In case of CFRP components with varying wall thicknesses, the ultrasonic signals which are already attenuated in CFRP materials, are further weakened. The mentioned signal damping is caused by different physical effects. A crucial factor of influence is the so-called anisotropy which means the directionality of certain material properties. Anisotropy affects sound signals to spread out along non-symmetric material directions, thus losing energy. Additionally, the ultrasonic signals are attenuated by the carbon fibers and the special behavior of the epoxy resin matrix.

Besides far-field approximations, the so-called Generalized Point Source Synthesis (GPSS), supplemented by approximation models, proved to be an efficient procedure to simulate ultrasound inspections in near- and far-fields.

Surround stereo – or better

A major challenge in practical ultrasound inspection is the choice of the appropriate insonification angle. Here, simulations can save a lot of time and efforts compared to experimental trial and error. Necessary modeling steps are related to the probe- and wedge-dependent calculation of the sound field impinging onto the backwall, to the calculation of the wavefield reflected from the backwall by appropriate approximation models, and to the calculation of the backwall signal received in impulse/echo mode.

Especially in case of phased array applications the calculation of the delay times depending on the fiber orientation is needed to compensate the influence of the directional sound velocities. Then, even inhomogeneous fiber orientations can be handled by appropriate simulations.

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