In-situ simulation for non-destructive evaluation of the spot welding process

Christian Mathiszik[1], Stefan Heilmann[1], Jörg Zschetzsche[1], Marcel Merx[2], Tomas Teren[2], Christoph Großmann[2], Jens Müller[2], Steffen Ihlenfeldt[2], Uwe Füssel[1]

[1]CHAIR OF JOINING TECHNOLOGY AND ASSEMBLY, Technische Universität Dresden, Germany,
[1]CHAIR OF MACHINE TOOLS DEVELOPMENT AND ADAPTIVE CONTROLS, Technische Universität Dresden, Germany

In advanced industrial manufacturing, resistance spot welding plays an important role. Due to the high efficiency and the achievable low cycle times, this method is increasingly used for challenging welding tasks. This results in smaller process windows with rising demands on the weld quality. A secure process control up to the quality assessment of each individual spot weld is necessary. Destructive testing methods cannot be used for a 100% test. For non-destructive testing, only ultrasonic testing after the welding process has so far been established industrially. In addition to NDT, the digitization of production and the unambiguous assignment of product and process data to a work piece along the entire process chain from the material to the finished product provide a large number of object-specific data and parameters ("big data"). This data can be used for the simulation-aided analysis of the work piece in each process step ("Digital Twin"), which can reduce the cost of the destructive and non-destructive testing. For this purpose, an in-situ simulation of the resistance welding process with the respectively work piece specific valid process data and parameters is carried out and automatically evaluated for each welding operations. Critical combinations can be identified and selected for further investigations. In addition, the in-situ simulation with a physically well founded description of the model allows the plant operator an intuitive insight into the fabricated spot weld by visualizing the weld nugget. This paper presents the theoretical approach to quality assessment and process optimization through in-situ simulation of resistance spot welding. The potential of this method to improve process control is shown on selected welded joints.