3D NUMERICAL SIMULATION OF FRICTION STIR WELDING PROCESSES WITH NON-CYLINDRICAL PIN: COMPARISON OF A FLUID AND A SOLID APPROACH

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Friction Stir Welding (FSW) process is a relatively recent welding process. It was invented at The Welding Institute (UK) in 1991. FSW is a solid-state joining process during which materials are not melted. So, the heat-affected zone (HAZ) is smaller and the quality of the welding is better with respect to more classical welding processes. In spite of the important number of applications of the FSW, the phenomena happening during the welding are still not well understood. Therefore, the investigations on this process and especially regarding numerical simulations are still very active, see e.g. [1]. As the material in the neighbourhood of the tool is submitted to extremely high strains, resulting from the mechanical intermixing of the two materials by the tool, advanced numerical simulation techniques have to be extended and developed in order to track the correct material deformation. One of these possible extended techniques is the Arbitrary Lagrangian Eulerian (ALE) formulation. This formulation is used to control the mesh displacement regardless of the real material displacement. It is also used to keep a correct mesh quality during the computation [2, 3]. Sometimes, it is also necessary to remesh at least a fraction of the simulation domain. During these remeshing phases, data are transferred thanks to an original method based on a linear reconstruction of the field on an auxiliary finite volume mesh [4].

The paper presents some comparison of two 3D models of FSW process: one based on a Fluid approach solving for the velocity field [5, 6, 7], and the other based on a Solid approach solving for the position field [2, 4, 8]. It is shown that these two formulations
essentially deliver the same results as far as the temperature and mechanical fields prediction during welding are concerned.

REFERENCES


