Easy Teaching of Numerical Simulation of Welding with COMSOL Multiphysics®

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Abstract

The initiation in numerical modeling of welding with COMSOL Multiphysics® is proposed to the 2nd year students of the professional master program «Processes, Controls, Metallic Materials: Nuclear Industry» (PC2M) of University of Burgundy, France since 2016 within the module «Simulation of welding physics». This training follows transversal aims:
• easy comprehension of the influence of operational parameters on weld properties;
• discovery of different kinds of physical phenomena of welding and their synergetic effect;
• hands-on experience of creation of multiphysical models.
The practical works are composed by four sessions of 3 hours, dedicated to the following subjects:
• time-dependent and pseudo-stationary formulations of welding problem in Heat Transfer module;
• parametrical studies of input parameters (material properties, welding velocity, preheating etc.) effect on melted zone dimensions;
• simulation of convection forces and the analysis of their synergetic effect on melted zone dimensions and temperature (strong coupling between CFD and Heat Transfer modules);
• the modeling of elements transport in the melted zone (strong coupling between CFD, Heat Transfer and Diluted elements transport modules).
Theoretical content and step-by-step description of models creation along with efficient post-processing tips are provided in form of richly illustrated work-book of 40 pages offered to each student. The students work in a pair and are evaluated basing on the report that contains the short description of the modeling steps and the vast discussion dedicated to the understanding of simulated phenomena and their impact on calculated thermal, velocity or composition fields as well as to the associated numerical challenges (effect of mesh size, stabilization, solving of convergence problems).
We hope that this course will promote the culture of multiphysical modelling amongst young specialists in manufacturing of metallic parts and structures, in particular for the nuclear industry.
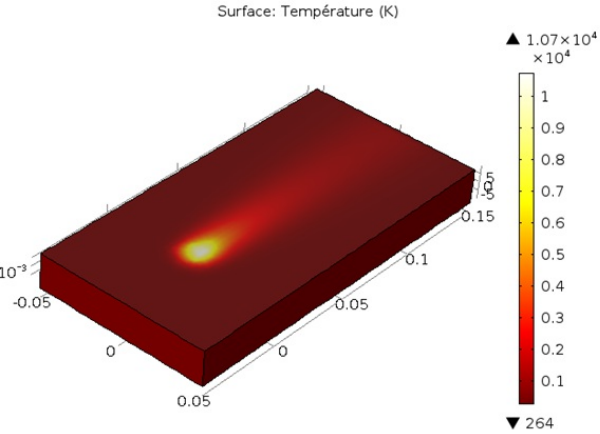
Figures used in the abstract

Figure 1: Heat transfer in welding.