C. R. Mecanique 346 (2018) 997–998

Contents lists available at ScienceDirect

Comptes Rendus Mecanique

www.sciencedirect.com

Computational methods in welding and additive manufacturing/Simulation numérique des procédés de soudage et de fabrication additive

Foreword

Numerical simulation is a tool widely used nowadays in the field of materials manufacturing processes, both in academic laboratories and in industry. Indeed, more than 40 years of development have led to efficient numerical methods implemented in robust codes. The power of the current computational resources makes it possible to enrich the physical models used and to carry out multi-physics and multi-scale couplings that are increasingly relevant. Similarly, the relationship between simulation and experimental approach is becoming ever closer and more dynamic. Obviously, the objectives are to predict the properties of the material, to anticipate possible defects, and ultimately to optimize the process, taking into account the different thermo-mechanical treatments applied.

Welding, which has been the subject of much work since the 1970s, is a perfect illustration of this evolution. Simulation of the various welding processes has always required (and still requires) the use of the most advanced numerical methods. Consider that the full simulation of a welding assembly process requires, in absolute terms, taking account of the passage from a solid to a molten state under the action of a heat source, the flow in this molten pool with surface tension and Marangoni effect, its interaction with the heat source, the cooling and the metallurgical transformations that go with, in order to predict the residual stresses and distortions or the initiation of cracks.

During this decade, additive manufacturing processes have matured technologically. Announced as a revolution, they have already changed, at least in some areas, our perception of materials manufacturing. These processes allow, on the one hand, the production of parts to be relocated as close as possible to the site of use; on the other hand, they allow the production of custom-made parts, with complex geometries that cannot be achieved by traditional manufacturing methods. However, beyond the technological aspect, the classic questions in materials manufacturing are still there: what is the quality of the manufactured part, how to optimize the process, how to optimize the geometry of the part? Strong similarities exist between metal additive manufacturing processes and welding processes. For example, in Powder Bed Fusion technologies, which are commonly used printing techniques, powder particles from particular regions of a powder bed are fused together by thermal energy. In this context, the strategies developed for modeling and simulating the welding processes are of great help in understanding the thermo-mechanical-metallurgical cycles that materials undergo during an additive manufacturing process.

The technological and scientific importance of ‘Computational methods in welding and additive manufacturing’ justifies that the journal *Comptes rendus Mecanique* devotes a thematic dossier to this topic. The present issue compiles eight peer-reviewed contributions giving an overview of the work performed in this area. We hope that this thematic issue brings to the readers’ knowledge new points of view and advances in the field and leads to further contributions to the journal on this topic.

As guest editors, we would like to thank the editorial staff and Jean-Baptiste Leblond, editor-in-chief, as well as all the authors and reviewers who helped make this dossier.

Julien Bruchon
École des mines de Saint-Étienne, Université de Lyon, CNRS, UMR 5307 LGF, Centre SMS, Departement MPE, 42023 Saint-Étienne, France
E-mail address: bruchon@emse.fr

Jean-Michel Bergheau
Université de Lyon, École nationale d'ingénieurs de Saint-Étienne, LTDS, UMR CNRS 5513, 58, rue Jean-Parot, 42023 Saint-Etienne cedex 2, France
E-mail address: jean-michel.bergheau@enise.fr

https://doi.org/10.1016/j.crme.2018.08.009

Romain Boman
University of Liège, Department of Aerospace and Mechanical Engineering, 9, allée de la Découverte, B-4000 Liège, Belgium
E-mail address: r.boman@ulg.ac.be

Available online 24 August 2018