

**Dissertation Release****13.05.2020**

# Peeking inside solid steel. A new monitoring and control strategy for FSW of ferromagnetic high-strength steels

<b>Title of the dissertation</b>	Friction stir welding of modern high-strength steels: Joint characterization and development of a magnetic-based process monitoring
<b>Contents of the dissertation</b>	This work presents a new online monitoring and control strategy for friction stir welding of ferromagnetic high-strength steels based on the relationship between the magnetic transformations of steel at vicinity of the Curie temperature and the intercritical temperature range, where thermomechanical processing leads to best combination of strength and toughness. The study includes comprehensive mechanical testing supported by microstructural analysis and measurements to determine the optimal range of processing temperatures. The real critical temperatures of the main targeted high-strength steel in this research, the 700MC+, are measured for different heating and cooling rates, via differential scanning calorimetry. Contactless magnetic-based monitoring systems, using eddy currents and Hall-effect sensors, were developed and tested on thermal and thermomechanical processing cycles. Monitoring the change of magnetic flux density near processed material is shown to provide real-time qualitative and quantitative information related to the temperature field within the intercritical temperature domain enabling the development of intelligent systems capable of controlling the phenomena that govern the metallurgical and mechanical properties of steels.
<b>Field of the dissertation</b>	Mechanical Engineering, Engineering Materials, Advanced Manufacturing
<b>Doctoral candidate</b>	Gonçalo, Sorger, M.Sc. (Mech. Eng.); Born in 06.05.1985
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<b>Opponent</b>	Professor Michael P. Short, Massachusetts Institute of Technology, USA
<b>Supervisor</b>	Professor Pedro Vilaça, Aalto University School of Engineering, Department of Mechanical Engineering
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