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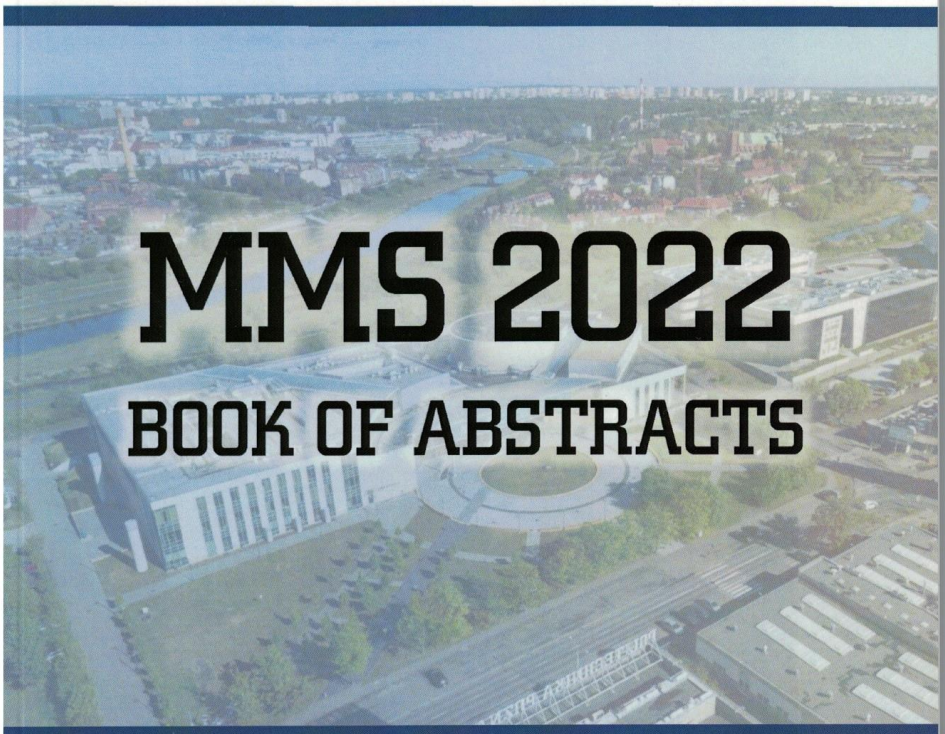

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Numerical modelling of thermal and structural phenomena in a lap joint of different materials welded by a laser beam

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The search for new technological solutions and the performance of innovative welded joints results from the needs of modern industries such as aviation, automotive and energy. Welded joints of dissimilar materials with different thermomechanical properties are used in many manufacturing solutions. One of the methods that is increasingly used in the production of such joints is a laser welding. Joints of dissimilar materials are difficult to perform due to the differences between thermomechanical properties, determined by the chemical composition of joined materials. Phase transformations in solid state are an additional problem of welding steel, because changes in the microstructure of steel caused by phase transformations generate additional deformations during welding. Numerical modelling of thermal and mechanical phenomena requires appropriate material models in a numerical algorithm for each material and the selection of various thermal properties of the process. The paper concerns a computer analysis of thermal and structural phenomena in a laser welded lap joint made of two types of steel with different properties. Numerical modelling of the laser welding process as a three-dimensional model is performed in the Abaqus FEA engineering software. Abaqus/Standard computational solver is supplemented with additional numerical subroutines enabling modelling of the power distribution of a moveable welding source. The numerical analysis takes into account the temperature-dependent thermomechanical properties of two different steels. The distribution of temperature in the joint is determined on the basis of performed calculations. The shape of melted zone and heat affected zone are numerically estimated. Numerically predicted structural composition of the joint is presented. microstructure tests and hardness tests of welded joint are performed in order to verify the applied numerical models.