World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:10, No:08, 2016

Parameters Identification and Sensitivity Study for Abrasive WaterJet Milling Model

Authors : Didier Auroux, Vladimir Groza

Abstract : This work is part of STEEP Marie-Curie ITN project, and it focuses on the identification of unknown parameters of the proposed generic Abrasive WaterJet Milling (AWJM) PDE model, that appears as an ill-posed inverse problem. The necessity of studying this problem comes from the industrial milling applications where the possibility to predict and model the final surface with high accuracy is one of the primary tasks in the absence of any knowledge of the model parameters that should be used. In this framework, we propose the identification of model parameters by minimizing a cost function, measuring the difference between experimental and numerical solutions. The adjoint approach based on corresponding Lagrangian gives the opportunity to find out the unknowns of the AWJM model and their optimal values that could be used to reproduce the required trench profile. Due to the complexity of the nonlinear problem and a large number of model parameters, we use an automatic differentiation software tool (TAPENADE) for the adjoint computations. By adding noise to the artificial data, we show that in fact the parameter identification problem is highly unstable and strictly depends on input measurements. Regularization terms could be effectively used to deal with the presence of data noise and to improve the identification correctness. Based on this approach we present results in 2D and 3D of the identification of the model parameters and of the surface prediction both with self-generated data and measurements obtained from the real production. Considering different types of model and measurement errors allows us to obtain acceptable results for manufacturing and to expect the proper identification of unknowns. This approach also gives us the ability to distribute the research on more complex cases and consider different types of model and measurement errors as well as 3D time-dependent model with variations of the jet feed speed.

Keywords : Abrasive Waterjet Milling, inverse problem, model parameters identification, regularization
Conference Title : ICIPSE 2016 : International Conference on Inverse Problems in Science and Engineering
Conference Location : Amsterdam, Netherlands
Conference Dates : August 04-05, 2016