Approaches for model validation: methodology and illustration on a sheet metal flanging process

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Approaches for Model Validation: Methodology and Illustration on a Sheet Metal Flanging Process

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Model validation has become an increasingly important issue in the decision-making process for model development, as numerical simulations have widely demonstrated their benefits in reducing development time and cost. Frequently, the trustworthiness of models is inevitably questioned in this competitive and demanding world. By definition, model validation is a means to systematically establish a level of confidence of models. To demonstrate the processes of model validation for simulation-based models, a sheet metal flanging process is used as an example with the objective that is to predict the final geometry, or springback. This forming process involves large deformation of sheet metals, contact between tooling and blanks, and process uncertainties. The corresponding uncertainties in material properties and process conditions are investigated and taken as inputs to the uncertainty propagation, where metamodels, known as a model of the model, are developed to efficiently and effectively compute the total uncertainty/variation of the final configuration. Three model validation techniques (graphical comparison, confidence interval technique, and r^2 technique) are applied and examined; furthermore, strength and weakness of each technique are examined. The latter two techniques offer a broader perspective due to the involvement of statistical and uncertainty analyses. The proposed model validation approaches reduce the number of experiments to one for each design point by shifting the evaluation effort to the uncertainty propagation of the simulation model rather than using costly physical experiments.

Issue Section: Technical Papers

Keywords: sheet materials, sheet metal processing, forming processes, deformation, finite element analysis, yield stress, work hardening, statistical analysis

Topics: Model validation, Uncertainty

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he science, engineering, and technology of sheet metal forming processes and die design continue to advance rapidly on a global scale and with major impact on the economies of all nations. In preparing this second edition, my goal throughout has been to provide an expanded and more comprehensive treatment of the sheet metal forming processes, while placing forming processes and die design in the broader context of the techniques of press-working sheet metal. Sheet-metal forming processes are used for both serial and mass production. Their characteristics include high productivity, highly efficient use of material, easy servicing of machines, the ability to employ workers with relatively lower basic skills, and other advantageous economic aspects. Continuous process verification (CPV) 42 has been introduced to cover an alternative approach to process validation based on a continuous 43 monitoring of manufacturing performance. This approach is based on the knowledge from product and 44 process development studies and / or previous manufacturing experience. CPV may be applicable to 45 both a traditional and enhanced approach to pharmaceutical development. It may use extensive in-46 line, on-line or at-line monitoring and / or controls to evaluate process performance. It is intended that 47 the combination of the Model validation is the process of evaluating a trained model on test data set. This provides the generalization ability of a trained model. Here I provide a step by step approach to complete first iteration of model validation in minutes. Shreyas Jothish. Feb 7, 2019·5 min read. The basic recipe for applying a supervised machine learning model are: Choose a class of model. Choose model hyper parameters. Fit the model to the training data. Use the model to predict labels for new data. From Python Data Science Handbook by Jake VanderPlas. Jake VanderPlas, gives the process of model validation i Abstract Deep drawing process is an important process adding values to flat sheet metals in many industries. An important concern in the design of a deep drawing process generally is formability. This paper aims to present the connection between formability and inverse analysis (IA), which is a systematical means for determining an optimal blank configuration for a deep drawing process. In this paper, IA is presented and explored by using a commercial finite element software package. 2006. Approaches for model validation: methodology and illustration on a sheet metal flanging process. ASME Journal of Manufacturing Science and Engineering 128 (2):588-597. 805.