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Please fill in your abstract title.	Prediction of Surge Volumes using Machine Learning

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Abstract

Objectives/Scope: Prediction of surge volumes is often a challenging, but necessary, component of multiphase system design. Slugging, pigging, production rampup and other operational scenarios in multiphase production systems can result in large volumes of liquids being swept out of the pipeline and into the first vessel on the receiving facility. Quantifying the surge volumes for all anticipated system operating modes can be difficult and engineers often resort to oversimplification or running excessively large numbers of simulations to assess this problem. This topic will examine how the use of an Artificial Neural Network regression model can be used to reduce the number of simulations which are required whilst not resorting to oversimplifications.

Methods, Procedures, Process: Wood was tasked with developing a restart strategy for an offshore gas-condensate system which was faced with the problem of large liquid surge volumes with limited space, weight and power constraints on the topsides platform. However, due to the large number of input variables, the total number of permutations of possible operating conditions was excessively large (over 40,000 scenarios) and simulating all the scenarios in a multiphase flow simulator would be impractical due to long simulation times. To cope with tight deadlines, just a small subset (~500) scenarios were simulated instead. A deep, fully connected artificial neural network model with multiple hidden layers, which is based loosely on the architecture of the human brain, was then fit to the surge volume results and was subsequently utilized to predict the liquid surge on topsides for all the possible operating scenarios.

Results, Observations, Conclusions: The Artificial Neural Network model was used to rapidly predict the surge volumes for over 40,000 permutations in a matter of minutes with a correlation coefficient (R-squared
value) of 0.93. It is estimated that this process saved approximately 110 days of simulation time for the project. The Wood team utilised their knowledge and experience in designing/modelling process systems, combined with advanced machine learning techniques, to achieve this result. This demonstrates the value and necessity of having a fundamental understanding of the underlying process when applying these advanced analysis techniques to various applications.

Novel/Additive Information: The application of machine learning in day-to-day engineering applications is accelerating at a frantic pace. The application of these state-of-the-art data analytics methods in the oil and gas design space is expanding into new functional areas over various disciplines. By combing both flow assurance / process knowledge with machine learning techniques, deliver smarter, more efficient design solutions can be delivered.