Polytechnic University of Catalonia

Master in Numerical Methods

Communication Skills I
Assignment 1

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Project

"Obtention of plastic deformations in threaded connections of oil extraction components using artificial neural networks".
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Abstract

Plastic deformation determination in threaded connections of oil extraction components, for example pipes and sucking rods, are really important to evaluate the structural reliability of the extraction system.
Finite element method is generally used for the calculation of this plastic deformation, refining the mesh in areas where high concentration of stresses exists. The problem is that the running times for simulations vary between two and six hours (in a personal computer), depending on the loading cycles and the number of elements used in the mesh. The impact of calculation times gets amplified when it is necessary evaluate many connections in different types of pipes, usually taking several days to complete.
The use of machine learning tools, trained with results obtained from the finite element method, allows to reduce those calculation times drastically. Additionally real time evaluation tools can be developed using this approach, as results can be visualized in a matter of seconds.
Fast-forward artificial neural networks, with two layers of weighted nodes and trained with the classic backpropagation algorithm were specifically used to predict equivalent plastic deformation fields for the tooth of pipe connections, where most of the failures are registered due to high loads applied cyclically. This field depends on various parameters: loads applied when adjusting the connection, geometry of the tooth in the thread, active load and other parameters as thermal treatments of the surface of the components.
The program developed, using Matlab Neural Network Toolbox ^{TM}, proved to have an outstanding prediction precision taking into account the complexity of plastic analysis, as it delivered results for untrained cases with errors smaller that two percent, with a clear identification between elastic and plastic zones.