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A Method for Sensitive Analysis of Workpieces Rupturre During Extrusion Processes

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Abstract
This paper describes a method for sensitive analysis of workpieces rupture during extrusion processes. The proposed approach includes finite element simulation and neural networks analysis. The simulation can predict forming defects such as cracks initiation and propagation within the workpiece. Because Finite element simulation is a time consuming repeated analyses, the neural networks are employed in this investigation as numerical devices for substituting the finite element code needed for the workpiece defect prediction. The results obtained by simulation in the case of extrusion show that the risk of appearance of defects is localized to external surfaces, which is in conformity with experimental observations. A back propagation training neural network model was trained by using the numerical results. The network has been employed as numerical devices for substituting the finite element code needed for the maximum damage prediction within the extruded part.

Keywords: Reliability, Failure, Extrusion processes, Sensitive analysis, Finite element, Neural network.

References:

[1] M. T. Todino, „Estimating the probabilities of triggering brittle fracture associated with the defects in the materials", Materials Science and Engineering A, Volume 302, Issue 2, 2001, p: 235-245.
[2] V. Papadopoulos Papadrakakis, and N.D. Lagaros, „Structural reliability analysis of elastic-plastic structures using neural networks and Monte Carlo simulation" Comput. Methods Appl. Mech. Engrg. 136, 1996, p: 145-163.
[3] K. Lange, „Handbook of metal forming", McGraw-Hill Book Company, 1985.
[4] P. Hartley, I. Pillinger, and C. Sturgess, „Numerical modeling of material deformation processes research, development and applications", Springer-Verglag, 1992.
[5] Proceeding of Advanced Methods in Material Processing Defects Int. Conf., (Paris), July 1997.
[6] R. Hambli, and A. Potiron, „Finite element modeling of sheet-metal blanking operations with experimental verification", Jour. of Mat. Proc. Tech., 2000, p: 257-265.
[7] R. Hambli, „Numerical fracture prediction during sheet-metal blanking processes", Engineering Fracture Mechanics, Volume 68, Issue 3, 2000, p: 365-378.
[8] S.E. Clift, P. Hartley, C.E.N. Sturgess and G.W. Rowe, „Fracture prediction in plastic deformation process", Int. J. Mech. Sci. Vol.32 n°1, 1990, p: 1-17.
[9] J.L. Chaboche, „Continuous damage mechanics – A tool to describe phenomena before crack initiation", Nucl. Engrg. Des. 64, 1981, p: 233-247.

[10] J. Lemaitre, „A continuous damage mechanics model for ductile fracture“, Journal of Engineering Materials and Technology, Vol. 107, 1985, p: 83-89.
[11] A.L. Gurson, „Continium theory of ductile rupture by void nucleation and growth“, J. Eng. Materials and Technology, Trans. of the ASME, Vol. 99, 1977, p: 2-15.
[12] V. Tvergaard, „Material failure by void growth to coalescence“, Advances in Applied Mechanics 27, 1990, p. 83-151.
[13] ABAQUS – HKS theory manual – Version 5.8
[14] M.A. Criesfield, „Non linear finite element analysis of solids and structures“, Vol. 1, Wiley, 1991.
[15] J.M.M. Marques, „Stress computation in elastoplasticity“, Eng. Comput., Vol. 1, 1984.
[16] M.Y. Rafiq, G. Bugmann and D.J. Easterbrook, „Neural network design for engineering applications“, Computers & Structures, Vol. 79, Issue 17, 2001, p: 1541-1552.
[17] Z. Waszczyszyn, and L. Ziemiaski, „Neural networks in mechanics of structures and materials - new results and prospects of applications“, Comp. & Struc., Vol. 79, Issues 22-25, 2001, p: 2261-2276.
[18] J.E. Hurtado, and D.A. Alvarez, „Neural-network-based reliability analysis: a comparative study“, Comp. Methods in Applied Mechanics and Engineering, Vol. 191, Issues 1-2, 9, 2001, p: 113-132.
[19] J.E. Hurtado, „Analysis of one-dimensional stochastic finite elements using neural networks“, Probabilistic Engineering Mechanics, Volume 17, Issue 1, 2002, p: 35-44.
[20] E.M.A. El-Kassas, R.I. Mackie, and A.I. El-Sheikh, „Using neural networks in cold-formed steel design“, Computers & Structures, Vol. 79, Issue 18, 2001, p: 1687-1696.
[21] G. Bugmann, „Normalized radial basis function networks. Neurocomputing“, [special issue on Radial Basis Function Networks] 20, 1998, p: 97-110.
[22] W.M. Jenkins, „An introduction to neural computing for the structural engineer“, The Struct Engng 75 3, 1997, p: 38-41.