Some Observations on Comparing the Modelled and Measured Residual Stresses on the Machined Surface Induced by Orthogonal Cutting of AISI 316L Steel

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Abstract

The rapidly increasing number of different finite element models which predict residual stresses induced in machining raises several questions about the correctness/validity and relevance of these methods, particularly when comparing the measured values of residual stresses on the machine surface with those predicted. The objective of this paper is to attempt to answer some of these questions regarding such comparisons. To achieve this objective the case of residual stress distributions induced by the orthogonal cutting process of the AISI 316L steel using uncoated tungsten carbide tools is studied experimentally and numerically. For experimentation, the X-ray diffraction technique was applied in measurements, while a thermal elasto-viscoplastic finite element model was used for predictions. The results show that the comparison between predicted and measured residual stresses, only has meaning if the predicted residual stresses are extracted from the FEM model under the same conditions as those applied experimentally and that the associated assumptions are very critical for achieving a correlation. These conditions will also depend on the particular experimental technique and procedure used to measure the residual stresses.