

# Finite Element Modeling of Residual Stress Profile Patterns in Hard Turning

Y.B. Guo\*

Dept. of Mechanical Engineering, the University of Alabama, Tuscaloosa, AL 35487, USA

## Abstract

Hard turning produces the unique “hook” shaped residual stress (RS) profile characterized by surface compressive RS and subsurface maximum compressive RS. However, the formation mechanism of the unique RS profile is not yet known. In this study, a novel hybrid finite element modeling approach based on thermal-mechanical coupling and internal state variable plasticity model has been developed to predict the unique RS profile patterns by hard turning. The most important controlling factor for the unique characteristics of residual stress profiles has been identified. The predicted characteristics of residual stress profiles favorably agree with the measured ones. In addition, friction coefficient only affects the magnitude of surface residual stress but not the basic shape of residual stress profiles.

**Keywords:** Residual stress, modeling, machining, finite element

---

\* Corresponding author. Tel.: +1 205 348 2615; fax: +1 205 348 6419.  
E-mail address: yguo@eng.ua.edu (Y.B. Guo).