Exact spring-back behaviour prediction with subloading surface elastoplasticity model

Motoharu Tateishi* and Koichi Hashiguchi[†]

[*] MSC Software Ltd. (MSC)
Shinjuku First West 8F
23-7, Nishishinjuku, 1-chome,
Shinjuku-ku, Tokyo 160-0023, Japan
e-mail: motoharu.tateishi@mscsoftware.com, web page: http://www.mscsoftware.com

[*] MSC Software Ltd. (MSC)
Shinjuku First West 8F
23-7, Nishishinjuku, 1-chome,
Shinjuku-ku, Tokyo 160-0023, Japan
e-mail: koichi.hashiguchi@mscsoftware.com, web page: http://www.mscsoftware.com

ABSTRACT

The conventional elastoplastic constitutive equation assuming perfect elasticity inside of the yield surface has been used for elastoplastic analysis by nonlinear finite element method. On the other hand, the subloading surface elastoplastic constitutive equation [1]~[4] has the basic structure that the plastic strain rate is always induced even in a low stress state.

With the elasto-plastic traditional constitutive equation, it was difficult to precisely predict the spring back behavior after deep drawing metal forming process, in which material behavior during re-yielding in the reverse loading state is important. In particular, the amount of spring back of high tensile strength steels with initial yield stress of over 1 GPa, which are being used as automobile parts for weight reduction purpose in recent years, is bigger than conventional sheet metal and hard to predict.

In this paper, we discuss on the implementation of subloading surface elastoplasticity model into Marc implicit nonlinear finite element code and the effectiveness of sheet metal forming analysis using the subloading surface model in Marc which describes elasto-plastic material behavior even in reverse loading state accurately.

REFERENCES

[1] Hashiguchi, K., Constitutive equations of elastoplastic materials with elastic-plastic transition, Journal of Applied Mechanics,Vol.47 (1980), pp.266-272.

[2] Hashiguchi, K., Subloading surface model in unconventional plasticity, International Journal of Solids and Structures, Vol.25(1989), pp.917-945.

[3] Hashiguchi, K., Ueno, M. and Ozaki, T., Elastoplastic model of metals with smooth elastic-plastic transition, Acta Mechanica,Vol. 223 (2012), pp.985-1013.

[4] Hashiguchi, K., Elastoplasticity Theory, Springer (2013).