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Abstract:

Incremental sheet forming (ISF) is a flexible process for rapid manufacturing of complex sheet metal parts. An advantage of ISF is the improved formability than traditional sheet forming processes such as stamping. A number of fundamental studies have been conducted to investigate the enhanced ISF formability considering the effects such as bending under tension and through thickness shear. To further understand the ISF deformation mechanism and formability enhancement, this work presents a new analytical model which is focused on investigating the deformation stability and its effect on the metal sheet fracture. Based on this new model, the critical strain of deformation instability is obtained. Furthermore, influences of the work-hardening effect and bending effect on the deformation stability are investigated. To validate the analytical model, the fracture occurrence of two aluminum grades, AA1100 and AA5052, are investigated by using ISF experiment. Based on the analytical and experimental investigation, this study has concluded that bending plays a major role on ISF deformation stability. In addition, the ISF fracture depends on both deformation stability and the sheet material's ductility.