Non-destructive evaluation of ferromagnetic material using metal magnetic memory technique

Guoshuang Shui\textsuperscript{1}, Changwu Li\textsuperscript{1}

\textsuperscript{1}Department of Engineering Mechanics, Beijing Jiaotong University

gsshui@bjtu.edu.cn

Abstract

Based on the measurement of residual magnetic spontaneous stray field, metal magnetic memory (MMM) technique is an effective method in evaluating the degree of early damage for ferromagnetic materials due to the existence of stress concentration. In this paper, the normal and tangential components of the stress induced self-magnetic leakage field (SMLF) intensity on the surface of specimens were measured at predetermined stress levels throughout the tensile process. The results show that the stress induced normal and tangential components of the self-magnetic leakage field are effective in characterizing different stress levels in elastic deformation stages; and the tangential component is more effective in characterizing different plastic deformation stages. Furthermore, experimental measurements using nonlinear ultrasonic technique (NUT) were also conducted. It shows that MMM technique is effective in characterizing the stress-strain state in elastic deformation stage for ferromagnetic materials; and NUT is more effective in characterizing the degree of plastic deformation.

Keywords: Metal magnetic memory, Damage, ferromagnetic material, Stress concentration, nonlinear ultrasonic wave