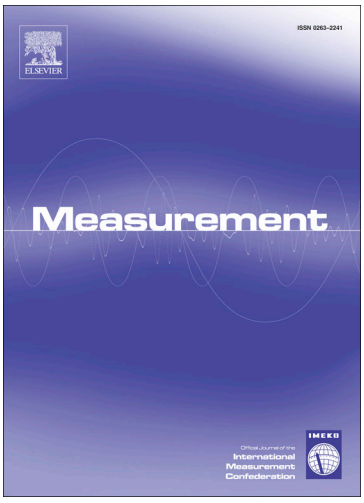

Strain-based health monitoring and remaining life prediction of large caliber gun barrel

Bin Wu, Bang-jun Liu, Jing Zheng, Tao Wang, Rong-gang Chen, Xiao-lei Chen, Kai-shuan Zhang, Zhi-qiang Zou

PII: S0263-2241(18)30139-8
DOI: https://doi.org/10.1016/j.measurement.2018.02.040
Reference: MEASUR 5288

To appear in: *Measurement*

Received Date: 25 January 2017
Revised Date: 5 December 2017
Accepted Date: 21 February 2018

Please cite this article as: B. Wu, B-j. Liu, J. Zheng, T. Wang, R-g. Chen, X-l. Chen, K-s. Zhang, Z-q. Zou, Strain-based health monitoring and remaining life prediction of large caliber gun barrel, *Measurement* (2018), doi: https://doi.org/10.1016/j.measurement.2018.02.040

Strain-based health monitoring and remaining life prediction of large caliber gun barrel

Bin Wu*, Bang-jun Liu, Jing Zheng, Tao Wang, Rong-gang Chen, Xiao-lei Chen, Kai-shuan Zhang, Zhi-qiang Zou

Department of Mechanical Engineering, Army Artillery and Air-defense Force Academy, Hefei 230031, China

Abstract: When a large caliber rifled gun fires, wear and fatigue damage the gun barrel and lead to the end of its useful life. It is important to understand the gun barrel condition during its service time and to predict the remaining useful life. In this paper, three traditional life prediction methods, including heat-based, dimension-based and velocity-based method, are summarized and proved to be insufficient for predicting the remaining useful life. A novel strain-based approach to life prediction of gun barrel is presented and analyzed theoretically, in which the strain of the outside surface of gun barrel is selected as a health index of the gun barrel. A large number of laboratory experiments on engraving small caliber projectiles have been carried out to verify the reasonability and feasibility of this strain-based method. Self-made copper and brass jacketed projectiles were pushed through a short gun barrel section under quasi-static and dynamic loading. The hoop and axial strains were measured using strain gauges and stored for analysis. Experimental results are listed as follows. (1) The measured strains do reflect the interaction between projectile and gun barrel under different test conditions. (2) Material property of jacket and diameter of projectile have influence on the external strains. (3) The jacket undergoes friction and plastic deformation during the engraving process. Effects of strain rate and thermal softening play critical roles in affecting the projectile and gun barrel interaction. This finding helps to explain that higher strains at low charges and lower strains at high charges occur to a 155 mm gun during firing practice.

Key words: Health monitoring; Life prediction; Gun barrel; Strain; Wear and fatigue