MAPAN
Journal of Metrology Society of India

DOI 10.1007/s12647-014-0126-9

Springer

Original Paper

Efficient Methods for Evaluating Task-Specific Uncertainty in Laser-Tracking Measurement

J. Yang, G. Li, B. Wu, J. Gong, J. Wang and M. Zhang

College of Mechatronics and Automation, National University of Defense Technology, Changsha 410073, China

G. Li
Email: lgx2020@sina.com

Received: 09 April 2014 / **Accepted:** 22 November 2014 / **Published online:** 3 January 2015

Abstract
For task-specific coordinate metrology, it is necessary to associate with task-specific parameters an estimate of their uncertainty at a specified level of confidence. In recent years, various sources of uncertainty for laser trackers themselves have been studied. However, methods for determining the uncertainty in laser-tracker-based task-specific measurement must be further studied. In this paper, the guide to the expression of uncertainty in measurement (GUM) uncertainty framework (GUF), the Monte Carlo method and a hybrid method combining grey evaluation and neural network technologies are used to evaluate the task-specific uncertainty in laser-tracking measurement. First, this article discusses the contributions to measurement uncertainty in specific laser-tracking measurement, including instruments themselves, data fusion, measurement strategies, measurement environment and task-specific data processing. Second, the principles of GUF, Monte Carlo and the aforementioned hybrid method are presented. Finally, a case study involving the uncertainty evaluation of a cylindricity measurement process using the above-mentioned methods is illustrated. The results demonstrate that these methods have different characteristics in task-specific uncertainty evaluation.

Keywords
Laser tracker – Measurement uncertainty – Monte Carlo – GUF – Grey evaluation – Neural network