Correction of the Systematic Errors of 3D Scanner Measurements by Data Fusion with CMM Data

Mathieu Latulippe¹, Farbod Khameneifar², J.R.R. Mayer³
¹Department of Mechanical Engineering, Polytechnique Montreal, Montreal, Canada
mathieu.latulippe@polymtl.ca
²Department of Mechanical Engineering, Polytechnique Montreal, Montreal, Canada
farbod.khameneifar@polymtl.ca
³Department of Mechanical Engineering, Polytechnique Montreal, Montreal, Canada
rene.mayer@polymtl.ca

ABSTRACT

Technological advances in additive and subtractive manufacturing are making it easier to produce parts with complex geometries. When the design tolerances are in micrometers, the task of inspecting those parts is complex and expensive. Currently, no measuring instrument can perform both geometric and dimensional inspection with high resolution and high accuracy. This work considers a coordinate measuring machine (CMM) and a 3D scanner. A CMM can take measurements of high accuracy but with a low density of points, and the 3D scanner can take measurements of low accuracy but with high density. This project aims to exploit each instrument's strengths with a data fusion technique to perform a geometric and dimensional inspection of complex machined parts. The result of the fusion should be a high-accuracy, high-density mesh representation of the measured part. A data fusion technique that uses a 3D scanner's high-density mesh representation, corrected by a non-rigid transformation to fit CMM points as a reference is proposed. The algorithm is a version of the Non-Rigid Iterative Closest Point algorithm with a point-to-surface distance metric. It allows for global deformations to correct systematic errors but not local ones, to preserve small details. The method has been validated on part samples and shows promise in correcting systematic errors in 3D scanner measurements.