# Compliant Assembly Variation Analysis Using Component Geometric Covariance

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Dimensional variation is one of the most critical issues in the design of assembled products. This is especially true for the assembly of compliant parts since clamping and joining during assembly may introduce additional variation due to part deformation and springback. This paper discusses the effect of geometric covariance in the calculation of assembly variation of compliant parts. A new method is proposed for predicting compliant assembly variation using the component geometric covariance. It combines the use of principal component analysis (PCA) and finite element analysis in estimating the effect of part/component variation on assembly variation. PCA is used to extract deformation patterns from production data, decomposing the component covariance into the individual contributions of these deformation patterns. Finite element analysis is used to determine the effect of each deformation pattern over the assembly variation. The proposed methodology can significantly reduce the computational effort required in variation analysis of compliant assemblies. A case study is presented to illustrate the methodology.