Fitting Multidimensional Measurement Data to Tolerance Zones Having Regard for the Uncertainties of Measurements

Plática Invitada

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ABSTRACT

The proper evaluation of geometrical tolerances very often requires best-fitting of the measured data to the Nominal Geometry or to another part of the same kind. Examples of such cases:

- Profile tolerance when no Datums are given at all
- Datum Reference Frame (DRF) does not fully constrain the part
- If DRF mobility is present due to MMC or LMC modifiers best-fitting of the measured data to the nominal geometry is mandatory.

Typically, as a result of the analysis which involves the best-fitting a conclusion is made about the suitability of the part – “accepted”, “rejected”, “needs a particular rework”, etc. It is known that the reliability of these statements (conclusions) can be only as good as the quality of the input data which is characterized by its uncertainty of measurement. The uncertainties of measurements can vary for each individual point or feature.

In the last 15 years the international community has been putting a lot of efforts in creating methods and tools for estimating the uncertainties of measurements. The ISO has published the GUM (Guide to the Expression of Uncertainty in Measurement) and the ISO 14253-1; 1998 standard which proposes “decision rules for proving conformance or non-conformance with specifications”. In the USA the ASMEB89 committee has issued the B89.7.3.1-2001 standard for the same purpose. They both stress the importance of the measurement uncertainty and the effect it has on the decision making for part acceptance or rejection. Both standards give guidance on what to do if the results, the tolerances and the measurement uncertainties are known in order to accept or reject the parts being controlled.

The normal practice involves first best-fitting the measured data from a part to the tolerance zone. The best-fitting process itself **does not** use the uncertainties of the measurements and the results of the best-fitting are independent from the magnitude of the uncertainties of measurements. If the uncertainties of measurements are known and the above mentioned standards are used to make the decision, after the best-fitting acceptance (conformance) or rejection zones are derived using the uncertainty of the measurements. Since the uncertainties of the measurements are not taken in consideration the achieved solution is not optimal from part acceptance or rejection point of view.

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