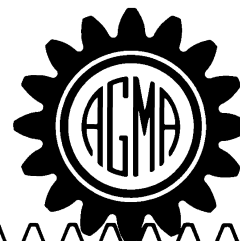


Certificate for Involute Gear Evaluation Software

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American Gear Manufacturers Association



TECHNICAL PAPER

Certificate for Involute Gear Evaluation Software

Frank Härtig, Physikalisch-Technische Bundesanstalt

[The statements and opinions contained herein are those of the author and should not be construed as an official action or opinion of the American Gear Manufacturers Association.]

Abstract

A test for the verification of involute gear software has been developed at the Physikalisch-Technische Bundesanstalt (PTB). The paper show the critical influence on the measurement uncertainty of uncertified involute evaluation software. Beside the test parameter information of the most dominant effects of software errors will be explained. The algorithms developed during this project should influence and complete existing standards and guidelines.

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Introduction and background

In the past, the reliability of an involute gear measurement is verified only by measurements on calibrated artifacts. Commonly, these artifacts are representing all important gear parameters of an involute gear with unmodified flank surfaces. Because of their physical shape, these artifacts (e.g. profile-, lead- and pitch-artifacts) are in the following referred to as “geometrical artifacts”.

The results of the measurements on geometric artifacts mainly allow conclusions regarding errors resulting from the operation of the measuring instrument, influences from environmental conditions and errors of the measuring process. Geometric artifacts are therefore used as masters to adjust the measuring instrument, to perform the acceptance test on measuring instruments or to validate and monitor measuring processes.

With the evaluation of modified flank surfaces and the spatial determination of the measurement points, the influence of data processing on the accuracy of a measuring process has considerably increased. In 1982, this development caused the expert committee “Measurements on Gears and Gearing” of the Verein Deutscher Ingenieure (VDI, Association of German Engineers) to perform a first investigation. Among the members, who are mainly composed of manufacturers of measuring instruments and gears, test data were distributed with the aid of which the different software products were. The test data were based on measurement values recorded on modified profile and flank surfaces. The results were alarming. In many cases, the values differed by several micrometers. Due to the lack of reference algorithms or reference data sets, no statements could at that time be made on the accuracy of the individual software products.

In view of this alarming situation, the Physikalisch-Technische Bundesanstalt (PTB) has in 2001 taken up activities for the validation of evaluation algorithms. Together with 7 partners from industry, a first research project “Evaluation of gearing algorithms”

was initiated [1]. Its aim was the certification of evaluation algorithms on the basis of existing guidelines and standards. Taking into account the experience already gained, the decision was taken to generate the measurement values synthetically. This strategy allowed suitable test cases to be established and contradictions to be eliminated in a simple way. As in the case of the first test performed 19 years ago, test data were distributed among the project partners. As expected, the differences again lay far above the specified tolerance of the respective involute gear (Figure 1a). Towards the end of the project (Figure 1b), the measurement results lay, however, within the permissible deviation of $0.1 \mu\text{m}$.

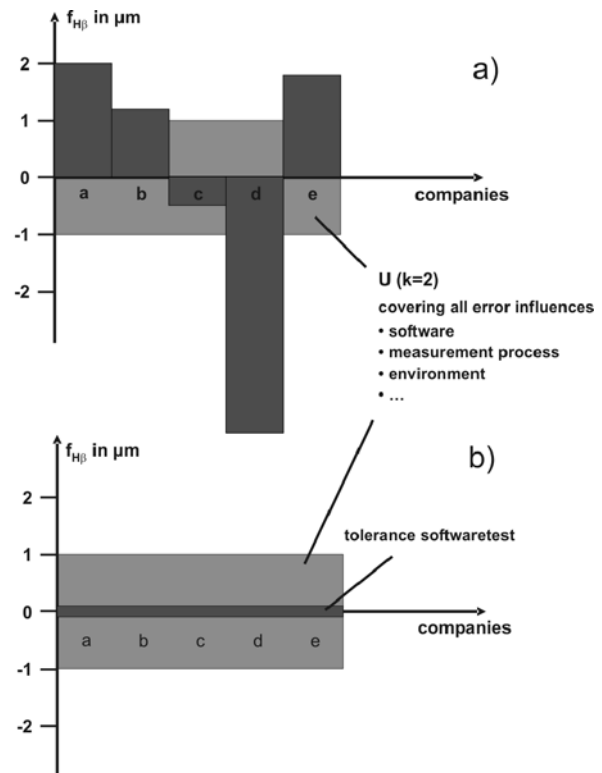


Figure 1: Measurement results at the beginning a) and at the end b) of the first software test

Since September 2005, the second research project “Evaluation of gearing algorithms – phase II” has been performed – also in cooperation between in-