

Master 2017

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Evaluation of a Method for Shape Reconstruction from Gradient Data.

ABSTRACT - Masterthesis

When a freeform surface is measured, a discrete dataset with surface information is generated. To reconstruct a continuous surface representation, an appropriate interpolant has to be found. One method to find this interpolant has been proposed by Ettl et al. The method is based on the surface reconstruction with radial basis functions using surface gradient data. In order to find the best method for the reconstruction of freeform surfaces, this method has been analyzed, evaluated, simulated and used in experiments within this work. Therefore, it has been compared to other methods to reconstruct a surface using radial basis functions. Also, different surfaces have been observed to evaluate the performances of the different reconstruction methods.

One major difference has been identified between the method proposed by Ettl et al. and the compared methods. Although, Ettl et al. state to use the Wendland's function as the basis function, they use the sum of its first derivatives for the surface reconstruction which leads to non-satisfying performances in the reconstruction process. In contrast, other methods that have been observed are using the Wendland's function as the radial basis function for the reconstruction. These methods show a much more satisfying performance.

To obtain the surface gradients in an experimental setup, a measurement method using experimental ray tracing is proposed and evaluated. This method includes a calibration which detects the incident ray into the system in respect to the coordinate system of the camera. Using this calibrated ray and the reflected rays from the device under test, the surface slopes of the device under test can be determined.

In this work, the method of Ettl et al. has been analyzed and compared to other methods to evaluate its performance. Additionally, a new measurement method to obtain surface data for the reconstruction using radial basis functions is proposed.