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Recognition of 3D Objects Based on Implicit Polynomials

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Abstract

This work deals with 3D objects description and recognition by implicit polynomials (IPs). We explore the description abilities of existing 3D implicit polynomials fitting algorithms, Gradient-One, Min-Max and Min-Var, and suggest a modification for the Min-Max and Min-Var algorithms, so that they will be rotation invariant. We develop a new set of 3D rotation invariants that are linear combinations of the IP coefficients, as well as a set of 3D quadratic and angular rotation invariants, using a tensor representation of the IP. We also obtain closed-form expressions for these invariants. We then present a 3D object recognition method which is based on the Multi Order and Fitting Errors Technique (MOFET) proposed earlier for 2D object recognition. This recognition approach is based on fitting several polynomials to the object surface, each having a different degree, and on their fitting errors. We demonstrate the recognition results on both a rigid objects database and a faces database (acquired in a cooperative situation). Simulation results show that our proposed method outperforms recognition based on IP fitting after pose estimation, as well as on the Shape Spectrum Descriptor (SSD) technique, which was adopted by the MPEG-7 standard.

Index Terms

Implicit polynomials, 3D object recognition, tensor contraction, rotation invariant, 3D object fitting, face recognition.