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Robust Fitting of 2D Curves and 3D Surfaces by Implicit Polynomials

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Abstract

This work deals with fitting 2D and 3D implicit polynomials (IPs) to 2D curves and 3D surfaces, respectively. The zero-set of the polynomial is determined by the IP coefficients and describes the data. The polynomial fitting algorithms presented in this paper aim at producing polynomials that are robust to coefficient errors. Special emphasis is given here to errors due to coefficient quantization. The development of the algorithms begins with an analysis of zero-set errors caused by coefficient errors. The result of this analysis provides means for evaluating the performance of existing fitting algorithms and for the development of new algorithms that yield more stable polynomials. We also show that although the proposed algorithms are designed to be robust to coefficient errors, they also produce tighter fits than the other algorithms examined, even when the coefficients are practically unquantized.