

Phenomenon of rationality in geometric modelling

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When the computers became available that allowed machining of 3D shapes, it appeared a necessity to define a computer-compatible description of those shapes. The most promising representation was soon identified to be in forms of parametric curves and surfaces. Unquestionably, the major breakthrough in geometric modelling was brought by the theory of polynomial Bézier and B-spline curves and surfaces, combined later with their rational counterpart. Hence, exploring the history of Computer Aided Geometric Design in industrial and related applications we can clearly see that study of rational techniques and rational representations were at the very foundation of geometric modelling. However, although Computer Aided Geometric Design and consequently a vast variety of geometrical applications is based on parametric piecewise rational representations, the major problem of CAGD is that many natural geometrical operations do not preserve rationality of derived objects (among the most frequent such operations belong offsetting, operation of convolution and Minkowski sums). Hence, studying the rationality belongs to challenging problems of geometric modelling.