Volumetric Representations (V-reps): Geometric Modeling of the Inside

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The needs of modern (additive) manufacturing technologies can be satisfied no longer by B-reps, as they require the representation and manipulation of interior fields and properties. Further, while the need for a tight coupling between the design and analysis stages has been recognized as crucial almost since geometric modeling (GM) was conceived, contemporary GM systems only offer a loose link between the two, if at all.

For about half a century, (trimmed) Non Uniform Rational B-spline (NURBs) surfaces has been the B-rep of choice for virtually all the GM industry. Fundamentally, B-rep GM has evolved little during this period. In this presentation, we introduce and examine an extended (trimmed) NURBs volumetric representation (V-rep) that, we believe, can successfully confront the existing and anticipated design, analysis, and manufacturing foreseen challenges. We extend all fundamental B-rep GM operations, such as primitive and surface constructors, and Boolean operations, to trimmed trivariate NURBs V-reps. This introduced representation enables the much needed tight link to (Isogeometric) analysis on one hand and the potential support of additive manufacturing of graded, anisotropic, and composites, on the other.

As part of the talk, we will also exemplify the power of V-reps in several applications, including additive manufacturing and the design of microstructures.

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[1]In collaboration with many others, including Fady Massarwi, Ben Ezair, Boris van Sosin, Annalisa Buffa, and Giancarlo Sangalli