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Visualització, Realitat Virtual i Interacció Gràfica

www.virvig.eu
C. Llorens i Artigas 4-6
Edifici U, 1er pis
E- 08028- Barcelona

Adaptive approximation of signed distance fields through piecewise continuous interpolation

Pujol, Eduard; Chica, Antoni

In this paper, we present an adaptive structure to represent a signed distance field through trilinear or tricubic interpolation of values, and derivatives, that allows for fast querying of the field. We also provide a method to decide when to subdivide a node to achieve a provided threshold error. Both the numerical error control, and the values needed to build the interpolants, require the evaluation of the input field. Still, both are designed to minimize the total number of evaluations.

C0 continuity is guaranteed for both the trilinear and tricubic version of the algorithm. Furthermore, we describe how to preserve C0 continuity between nodes of different levels when using a tricubic interpolant, and provide a proof that this property is maintained. Finally, we illustrate the usage of our approach in several applications, including direct rendering using sphere marching.

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