SEMINARIO DI GEOMETRIA

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Convolution Surfaces Generated by Basic 1D and 2D Skeletons

In this talk we present general closed form formulae for the convolution surfaces around sets of polygonal lines and planar polygons. Convolution is a technique used in computer graphics to generate smooth 3D volumes around a skeleton of lower dimension. One-dimensional skeletons create tubular like volumes which are well suited for modeling organic shapes. For general shapes one needs to consider 2D skeletons as well. Convolution surfaces are defined as level set of a function obtained by integrating a kernel function along this skeleton. To allow for interactive modeling, the technique has relied on closed form formulae for integration obtained through symbolic computation software. We consider families of kernels indexed by an integer that controls either the smoothness or the sharpness of the shape created. Generality is achieved by exhibiting the recurrence relationship for the convolution functions generated by line segments. The convolution functions for polygons are then expressed in terms of the convolution functions generated by the bounding polygonal line by application of Green's theorem. This approach does not require prior triangulation and simplifies a great deal the geometrical computations previously needed when dealing with compact support kernels. We believe that the material presented in this talk can serve as visual motivation for students to learn about symbolic integration as well as Green and Stokes theorem in differential geometry. Part of this work is in collaboration with M.-P. Cani (EPI EVASION) in the framework of the RTRA and ARC project PlantScan3D.

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