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Constructive Algorithms for Modeling Realistic Vascular Structures

The liver is the major metabolic organ in the human body as it fulfills a huge variety of vital metabolic tasks. The most important link between the liver and the rest of the organism is the blood flow through the three vascular systems (hepatic artery, portal vein, hepatic vein). In order to properly model the function of the liver, it is crucial to have an appropriate model of the blood transportation systems.

In vivo 3D CT imaging and subsequent image processing provides the structure of vascular systems with limited resolution far from the scale of individual lobule, sinusoids and liver cells on which the metabolic functions of the liver take place. To bridge this gap in resolution, models for vascular structures can be used. In the talk, we present an extension of the Constrained Constructive Optimization (Schreiner et al.) and the Global Constructive Optimization (Georg et al.) approach for hepatic blood vessels. Based on topological and geometrical analyses of many different human hepatic vascular structures, we evaluate these two algorithms. We introduce parameters and adapt them such that the generated vascular systems geometrically closely resemble natural ones. This resemblance is quantified by a statistical comparison to the geometric properties of real human hepatic vascular structures.