

Numerical simulations of three-dimensional tissues using Voronoi diagrams, and application to liver development

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The liver has a complex organization spanning multiple length-scales. At a small enough scale, it ultimately consists of a network of blood vessels (sinusoids) and a network of bile channels (canaliculi), separated by hepatocytes that must filter the blood from the sinusoids and secrete bile into the canaliculi. The tissue adopts a unique three-dimensional organization in which hepatocyte polarity is very different from the one observed in traditional epithelial tissues. Through theoretical modelling and analysis of experimental data, my goal is to uncover the fundamental mechanisms behind such an organization. Because the liver tissue is inherently three-dimensional, it requires new three-dimensional simulation methods. I will show how, using Voronoi diagrams, one can efficiently generate complex three-dimensional tissues in a computer, and I will present how to use this method in the case of the liver.

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