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Models for tumor growth and the Hele-Shaw asymptotic

The growth of solid tumors can be described at a number of different scales from the cell to the organ scales. For a large number of cells, the 'fluid mechanical' approach has been advocated recently by many authors in mathematics or biophysics. Several levels of mathematical descriptions are commonly used, including possibly elasticity, visco-elastic laws, nutrients, active movement, surrounding tissue, and several other features.

We will focuss on the links between two types of mathematical models. The 'microscopic' or 'compressible' description is at the cell population density level and a more macroscopic, description is based on a free boundary problem close to the classical Hele-Shaw equation. Asymptotic analysis is a tool to derive these Hele-Shaw free boundary problems from cell density systems in the stiff pressure limit. This modeling also opens other questions as circumstances in which instabilities may develop or the role of necrotic cores.

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