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Modelling and Numerical Simulation of Complex Fluids
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Modeling and numerical simulations of nanometric aerosols in the lower part of the bronchial tree

Project proposed by

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Framework and goals.

The classical model of the bronchial tree is divided into several different regions. Between the 8th and 17th tree generations, the air flow can be described through a Poiseuille law. Beyond, till the 23rd generation, the diffusion (Fick's law for instance) is the main phenomenon, and the convection can be neglected.

Therapeutic aerosols have to go very low in the bronchial tree (e.g. reach the pulmonary alveola). Several modelings are possible with respect to the mean size of the aerosol particles (statistical description with a kinetic equation, full description with a system of ordinary differential equations). The aerosol metrology is a key point, since the size of an aerosol particle has a strong impact on the location where the aerosol mainly deposits inside the airways.

We first aim to give coupled models for the air flow beyond the 8th generation and for an aerosol in which the size of the particles are scaled to the nanometer. Then some of the models must be numerically investigated, using for example, the finite element software Freefem++. The meshes involved in this work will be idealized, since the lower parts of the airways cannot be rebuilt using medical imaging.

The project is strongly related with some experimental studies led in the “Aerosols and bronchopneumonic cancer” team of Pr. Patrice Diot, in Tours.

Perspectives.

The involvement in this project may lead to a postdoc position at the INRIA Project Team Reo, on lung related topics.