Mechanical aspects of tumor growth

Resorting to a multiphase modelling framework, the lectures will be devoted to the description of the mechanical aspects influencing tumour growth. The starting point is the description of tumours as a mixture of tumour and host cells living in a porous structure constituted by a remodelling extracellular matrix (ECM), which is wet by a physiological extracellular fluid.

Mechanical aspect can then play a role in the definition of the growth term and in the interactions of the growing tumour with the host tissue, and in the attachment/detachment mechanisms between cells and ECM.

Starting from some recent experimental evidences, we propose to describe the interaction forces involving the extracellular matrix via some concepts coming from viscoplasticity and the evolution of the growing tissue via some concepts coming from the theory of evolving natural configuration.

In particular, in order to define the relationship between stress and strain for the cellular constituents, the deformation gradient is decomposed in a multiplicative way distinguishing the contribution due to growth, to cell rearrangement and to elastic deformation. On the basis of experimental results at a cellular level, it is proposed that at a macroscopic level there exists a yield condition separating the elastic and dissipative regimes. The relationship with previously proposed models is discussed as limit cases, e.g. fluid-like models are obtained in the limit of fast cell reorganisation and negligible yield stress.