Project Proposal

Project Description

A number of *in vivo* imaging modalities can assess tumor development in preclinical animal models and, potentially, in the clinical practice. These include optical techniques, computed tomography, ultrasound (US), nuclear imaging techniques, such as positron emission tomography and single-photon emission computed tomography, and magnetic resonance imaging (MRI).

In the last years, moreover, Cellular Imaging shows the potential to offer the opportunity for early detection of small numbers of metastatic cells and also provides the opportunity for studying micrometastatic processes in their earliest developmental stages in the target organs of interest. Among them, Cellular MRI is a growing field of imaging research that combines the high resolution of micro-MRI with "sensitive" contrast agents for cell and receptor labeling. This combination allows the investigation of biologic processes at the cellular level[1]. Indeed, the presence of this magnetic label in cells distorts the magnetic field and leads to signal hypo-hyper intensities (negative or positive contrast) in MR images. Furthermore, the information acquired can be matched and/or compared with those obtained by Cellular Optical Imaging[2].

The proposed PhD project aims to develop a broad range of biopolymer nanoparticulate contrast agents, as well as cell labeling techniques to stimulate a range of applications for MRI cell tracking to combine to the Optical Imaging. A variety of NPs-based labels will be tested at nano and micrometer range to evaluate the high payload ability to offer the possibility of significantly increasing tracing content in labeled cells.

The candidate will conduct interdisciplinary research at the interface of computational sciences and bioengineering developing high throughput nanomedicine tools to evaluate the molecular response (i.e. antibody, protein) in disease states ranging from infection to cancer in order to aid in the therapeutic compound design and development and to understand the biological and molecular mechanism of using nanomedicine approaches grounded in fundamental engineering principles utilizing protein evolution, molecular biology, and mathematical modeling.

Students with a Master Degree in bioengineering, chemical engineering, biomedical engineering, physics, or computational sciences and related disciplines are encouraged to apply.

Basic knowledge in the design and implementation of nanotechnology and computational biology will be considered relevant for the role. A letter of reference and motivation letter to work in the field are required.

Supervisor(s), Lab/Group details, other additional info.

The research will be supervised by Prof. Paolo Antonio Netti and Dr.-Ing. Enza Torino and carried on at the Interdepartmental Research Center on Biomaterials (CRIB) that will provide facilities and equipment to accomplish all the steps of Ph.D. proposal.

Funding
The research activities can count on national and international funding sources available at the multidisciplinary center.

References

1 Padmanabhan, P., Kumar, A., Kumar, S., Chaudhary, R. K. & Gulyas, B. Nanoparticles in practice for molecular-imaging applications: An overview. *Acta Biomaterialia* **41**, 1-16, doi:10.1016/j.actbio.2016.06.003 (2016).

2 Wang, Z. L. *et al.* Two-way magnetic resonance tuning and enhanced subtraction imaging for non-invasive and quantitative biological imaging. *Nature Nanotechnology*, doi:10.1038/s41565-020-0678-5.(2020)