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1
**CHIC – A Multi-scale Modelling Platform for in-silico Oncology**
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Models of normal physiology and disease are necessary in cancer research and clinical practice to optimally exploit the available (pre)clinical multi-scale and multi-modality data. Relevant models often cover multiple spatio-temporal scales and require automated access to heterogeneous and confidential data, making their development, validation and deployment challenging.
The CHIC (Computational Horizons in Cancer) [1] project develops computational models for the cancer domain, as well as tools, services and a secure infrastructure for model and data access, and reuse. The architecture is designed to support the creation of complex disease models (hyper-models) by composition of reusable component models (hypo-models). It aims to provide individualized answers to concrete clinical questions by patient-specific parametrization of disease-specific hyper-models.
We introduce the CHIC project and illustrate its approach to multi-scale cancer modelling by coupled execution of two component models operating on distinct spatial scales:
- OncoSimulator (OS): a spatially discrete model of cancer cell proliferation and treatment effect in function of tumour, treatment and patient-specific parameters [2], implemented as cellular automaton model,
- Bio-mechanical Simulator (BMS): a macroscopic continuum model of mechanical effects caused by tumour expansion in patient-specific anatomy, implemented as finite element model, based on [3].
Both component models exchange information about the spatial distribution of cancer cells and mechanical pressure in order to simulate the evolution of tumour volume and shape. Latter is achieved by correcting simple spherical growth (OS) by mechanically induced growth anisotropy (BMS). Results are demonstrated on the clinical example of Glioblastoma Multiforme.
CHIC is working towards an extensible platform for in-silico oncology with a set of reusable component models at its core, covering sub-cellular, cellular and super-cellular scales. Viability of infrastructure and composite hyper-models is being evaluated against clinical questions in the treatment of Nephroblastoma, Glioblastoma and Non-small Cell Lung Cancer.

Keywords: in-silico oncology, multi-scale modelling

References:
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2
**The symbiosis of science of radiation biology with immunology: Impact on basic and translational research**
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Recent evidence indicates that radiation is potent modulator of immune system. The field of radiation biology and immunology is at crossroads in cancer research. With this amalgamation, new clinical trials have emerged combining radiation therapy with immune modulating agents. Through this partnership, there is a promise to augment higher progression survival benefit than cancer immunotherapy as monotherapy. Merger of two fields can generate provocative themes that need the minds of basic immunologist to interact with radiation biologists to define radiation dose exposure, types of radiation, sequencing and dosing of vaccination and immune modulation biomarkers. Further, radiation biologist can learn from immunologist on what animal models can be utilized for primary and metastatic tumors. As the synergy is happening now between these two fields, there is greater focus in developing immune modulating agents for adjuvants to radiotherapy of solid tumors. This area is maturing for better understanding of the mechanistic actions of in-situ radiation vaccine. With this advent of advancement, there are vast opportunities to understand effects of radiation on tumor and normal tissue and how this damage cooperates with the host immune activation and injury. Such understanding can lead to identification of immune biomarkers that can be utilized in immune monitoring in tumor control and potentially synergize with other markers of normal tissue damage. This talk will focus on understanding the response of some key components of tumor immune microenvironment to radiation such as regulatory T-cells and myeloid cells in regulating immunogenic tumor cell death. The other focus will include how host immune machinery reacts to normal tissue injury and further any immune biomarkers can be validated for immune monitoring in clinical trials.

3
**Toward brachytherapy with ytterbium sources**
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Heavy and quite expensive afterloaders with iridium sources are now widely used for the HDR brachytherapy of tumors. The cost of this kind of treatment, as well as the necessity of heavily shielded canyons and of special technology of source delivery and replacement, makes the brachytherapy with iridium sources less widespread. Moreover, the relatively hard radiation of iridium-192 often makes damage to healthy organs close to a tumor.
These problems of HDR brachytherapy can be resolved with ytterbium sources. Compared to other isotopes used for HDR brachytherapy, the isotope Yb-169, having the average photon emission energy of 93 KeV, requires a much lighter shielding. For example, the tungsten shield of only 2-3 cm makes the HDR therapeutic ytterbium source harmless for the personnel. Therefore a source loader with ytterbium sources may be a compact and cheap desktop device. Moreover, the treatment quality may be significantly improved due to ytterbium radiation collimation. In the figure we compare two ytterbium dose distributions in water: one behind the tungsten layer of 2 mm (lower line) and the other without it. It follows form this figure that only 2 mm of tungsten allow to effectively collimate the ytterbium source radiation – the suppressed dose is 30 times lower! This also means that a new cheep and accurate preloader, let's call it an "acculoader", with a hidden ytterbium source inside can be easily manufactured. In this case the target irradiation will begin just by the source pushing forward.