Master's Thesis

MSLS: Applied Computational Life Sciences

Zurich University of Applied Sciences
Life Sciences and Facility Management
Institute of Applied Simulation

Title of project / Master's thesis	Exploring the effectiveness of cancer-immunotherapies for non-small lung cancer
Track	Digital Life Sciences
Topic / Key words	Lung cancer, mathematical modeling, programming
Supervisor	Victor Garcia, ZHAW / IAS
Co-Supervisor	Maria Anisimova, ZHAW / IAS
External partners	Universitätsspital Zürich
Place(s) of work	Wädenswil
Abstract	In the past, medicine has relied on three main modes of treatment for cancer: surgical removal of the cancerous lesions, radiotherapy and chemotherapy. In the last few years, a novel fourth mode has come into practice: immunotherapy. In immunotherapy, the adaptive immune system of the patient is stimulated to mount a response against tumor lesions. Researchers are seeking to improve the effectiveness of immunotherapy in various ways: one main way is to predict in which patients immunotherapy is efficient. To this end, we collaborate with researchers of the Curioni group as well as I.Burger and M. Messerli of the University Hospital Zurich, who treat lung cancer patients. The lab has gathered measurements of the standardized uptake values (SUVs) of the metastatic lesions – a proxy for the metabolic rate of the metastasis – from patients undergoing immunotherapy. We pursue a holistic approach that seeks to quantify immunotherapeutic effectiveness from the distribution of SUVs. To this end, we combine allometric scaling theory that relates total tumor masses with metabolic rate and a standard metastasis formation theory that describes the colony size distributions of metastases over time. The candidate will translate both theoretical models into code and fit these models to data. The fits will provide parameter and uncertainty estimates for the models. The candidate will also develop an approach to measure the effectiveness of immunotherapeutic treatment. This is ideally expressed as the rate of reduction of SUVs over time. The candidate will then explore the dataset to identify what information about the distribution of SUVs is predictive of therapeutic success and why.
Requirements	Knowledge of R, python, basic algebra and optimization techniques
Comments	
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Contact	Victor Garcia, gara@zhaw.ch