Abstract
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Modelling of Prostate Cancer Progression: Integrating Tumor Growth and Angiogenesis

Prostate cancer remains a major health concern worldwide. It is the second most commonly diagnosed cancer in males in the world, and it is placed fifth worldwide in terms of cancer deaths among men. Fortunately, there is a growing availability of therapies to treat this disease. In particular, proton therapy has gained increasing interest due to its depth vs. dose distribution, which allows for a tumour to be targeted while minimising healthy tissue exposure to radiation.

The heterogeneous nature of prostate cancer, both within a patient's tumour and among different patients, presents a challenge in diagnosis and treatment. For this reason, it is valuable to have strategies to personalise a patient's proton therapy treatment. Specifically, computational models can play an important role in monitoring patient's cancer progression and improving the patient's quality of life post-treatment.

Additionally, one of the hallmarks of cancer is angiogenesis. This phenomenon refers to the process of originating new blood vessels from the pre-existing vasculature, and is fundamental for tumour growth. Information about the angiogenic activity of a patient's tumour can be obtained with techniques such as multiparametric magnetic resonance imaging or through the analysis of biopsies. These data can be further used to personalise a treatment.

We propose a mathematical model based on the Fisher-Kolmogorov model, which describes prostate cancer growth. We aim to develop a model which also accounts for angiogenesis and the effect of proton therapy, which will be informed by longitudinal, patient-specific imaging and clinical data. Ultimately, this project's goal is to design optimal proton therapy regimens for patients. At this stage, we present a mathematical model for prostate tumour growth under the effect of vessel density dynamics. Besides this model, an algorithm for the growth of a vessel network was developed.