URJC Escuela Internacional de Doctorado

EULiST

PhD Thesis Project Offer

(valid during the calendar year 2025)

Provisional Title of the Doctoral Thesis

Probabilistic Optimal Planning of Cancer Therapies

Subject area* / Research line

Subject Area: Branch of Engineering and Architecture Research Line: Spectral Approach to Uncertainty Quantification in the Optimization of Stochastic Control Systems

Summary of the Doctoral Thesis (maximum 300 words)

The purpose of this project is applied research aimed at developing methodological advances that can be translated into real solutions for improving the efficiency of cancer treatment. In particular, the project seeks to contribute to the optimization of cancer therapy planning and its practical implementation, with the goal of reducing the physical and psychological impact on patients, based on criteria of efficiency and safety, through more intelligent and personalized therapies.

The planning of the administration of therapeutic agents over time, with the aim of optimally treating cancer, presents all the characteristics of a stochastic optimal control problem. Specifically, the objective is to minimize or maximize a given cost functional related to tumor burden and the patient's quality of life, while the underlying dynamic system represents as accurately as possible both tumor development and the interactions between the tumor and the treatment.

In this regard, the present research project is grounded in the application of optimal control methodologies and tools to analyze various parameterized models that describe the dynamics of both cancer cell populations and the elements of the associated tumor microenvironment, under the consideration of different anticancer therapies. The use of these optimal control tools implicitly involves the support of another mathematical discipline: the analysis of dynamical systems.

The study is enriched by the incorporation of a spectral uncertainty quantification methodology, which allows for the analysis of the effects of random factors on the control system—including global sensitivity analysis—as well as the management of uncertainty through probabilistic constraints. The spectral approach to uncertainty quantification requires the combination of two additional mathematical disciplines: functional analysis and measure theory.

The study is completed with the inclusion of scientific learning tools that will enhance the efficiency of implementing the various methodologies mentioned above.

Is the development of this thesis associated with the execution of any research project? If so, provide details of the project (title, funding entity, and execution period)

Currently not associated with the execution of any research project.

Academic Profile of the Student (maximum 200 words)

It is recommended that the student's academic background be grounded in university degrees in Mathematics, Physics, Data Analysis/Engineering, Biomedical Engineering, or equivalent fields, and include a solid foundation in mathematics—particularly in areas such as optimization, dynamical systems, control systems, functional analysis, and measure theory.

Contact: institutional email of the Supervisor

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*See the Subject Areas at https://www.urjc.es/informacion-practica#oferta-proyectos-de-tesis.
Each project will be included in a single subject area.