H.F.R.I.
Hellenic Foundation for Research & Innovation

Description of the funded research project

1st Call for H.F.R.I. Research Projects to Support Faculty Members & Researchers and Procure High-Value Research Equipment

Title of the research project: New Paradigms in Mathematical Finance: Modeling, Analysis, Computation

Principal Investigator: Antonis Papapantoleon

Reader-friendly title: New Paradigms in Mathematical Finance

Scientific Area: Mathematics

Institution and Country: NTUA, Greece

Host Institution: NTUA

Collaborating Institution(s): KAUST, WIAS, U. Porto

Budget: €170,000

Project webpage (if applicable):

Duration: 36 months

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Research Project Synopsis

This project deals with modern challenges in mathematical finance, arising from market developments (e.g. the rise of valuation adjustments after the financial crisis), as well as recent advances in the statistical analysis of financial data that led to the creation of rough volatility models. The aim of this project is to develop mathematical methods for the computation of option price bounds in the presence of model uncertainty, the valuation of option prices in rough volatility models, the Markovian representation of fractional stochastic processes, and the computation of prices in the presence of valuation adjustments.

Project originality

The aim of this project is to develop novel mathematical methods in order to tackle current problems in mathematical finance. We aim at developing efficient schemes for the computation of option prices bounds using ideas from optimal transport, optimization as well as the so-called Rearrangement Algorithm, that can work in high-dimensional situations. We also plan to develop numerical methods for the computation of option prices in rough volatility models using methods from machine learning as well as finite element schemes. In addition, we want to develop novel Markovian representations for fractional stochastic processes. Moreover, we want to develop efficient methods, based again on machine learning algorithms, for solving non-linear PDEs arising in the presence of valuation adjustments. These new results will be applicable not only in mathematical finance, but will broaden the horizon in several areas of mathematics, such as stochastic analysis and numerical analysis.

Expected results & Research Project Impact

The results of this research project include new mathematical and computational methods for tackling current problems in mathematical finance. In particular, they include novel methods for the modeling and computation of option price bounds in the presence of model uncertainty, that are adapted for high-dimensional situations. They also include new Markovian representations for fractional stochastic processes and the computation of option prices in rough volatility models. Moreover, they include efficient methods for the solution of non-linear PDEs associated with valuation adjustments.

These results have a significant scientific impact, as they deal with modern challenges in mathematical finance, and they require contributions in stochastic analysis and numerical analysis.

The results on bounds in the presence of model uncertainty can have an important social impact, by allowing for better risk measurement and management in financial markets and the amelioration of the effects of future crisis.

The importance of this funding

The generous funding from the HFRI is vital for this research project. It allows to attract and fund excellent research students and postdocs in my research group, which will carry out the ambitious research outlined in the proposal. Moreover, it allows to travel around the world to present our research results and to invite colleagues for scientific exchange from abroad.

This project could simply not be realized without the HFRI funding!

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