Ph.D Project EIPHI GS MALCOLM

Job title	Approximation methods for modern hyperbolic conservation laws
Job type (PhD, Post-doc, Engineer)	PhD
Contract duration (months)	36 months
Qualifications (Master, Ph.D …)	Master
Employer	UBFC Université Bourgogne Franche-Comté
Financing Institutions	Région Bourgogne Franche-Comté & Graduate School EIPHI
Host Laboratory	Laboratoire de mathématiques de Besançon
URL Host Laboratory	https://lmb.univ-fcomte.fr/
Address Host Laboratory	16 route de Gray, 25030 Besançon Cedex
Job description	Conservation laws are partial differential equations used in the modeling of physical, ecological or societal problems. For vehicular traffic, it is known that congested zones can arise from a free traffic: the formation of singularities from smooth initial conditions is a feature of conservation laws, which makes difficult their theoretical study. Thus, the methods of approximation play a fundamental role theoretically as well as numerically. The aim of this project is to study and to compare various non local regularization approximation methods. This theoretical part will be supported by the development of numerical schemes. The project is made of three parts that are connected but can be treated separately: - The first part follows from a question of Denis Serre. The goal is to study the distance between the standard viscosity regularization method and the one from Rosenau by investigating how this distance depends on the approximations parameters. This part is an extension of an on-going work from Alibaud, Coclite and Donadello. - The second part is dedicated to approximation methods for conservation laws set on networks, where the solutions depend on the transmission conditions imposed on the nodes. The goal here is to develop numerical schemes, that will be extensions of finite-volume methods in order to take into account these transmission conditions, and to study the impact of some regularization approximations. - The aim of the third part is to develop numerical schemes, based on finite-volume methods, for fractional approximations of conservation laws. The finite-volume methods are well adapted for the standard discretization of conservation laws. But their extension to conservation laws with fractional terms is not straightforward. The goal of this part is to study several possible extensions focusing on their precisions and their computational coasts.
Supervisor(s)	Carlotta Donadello (carlotta.donadello@univ-fcomte.fr) and Ulrich Razafison (ulrich.razafison@univ-fcomte.fr)

Candidate profile	To pursue this thesis, the candidate should have a Master degree. He or she should be interested in applied mathematics, have good skills in mathematical analysis and numerical analysis of partial differential equations. The candidate should also have good affinity in programming (Python or C++).
Keywords	Conservation laws; Mathematical analysis; Numerical analysis; Scientific computing; Modeling; Traffic flow
Application deadline	01/06/2022
Application Depending on the type of position	Please send the following documents (all in one PDF file) by e-mail to ulrich.razafison@univ-fcomte.fr: 1) For EU candidates: Copy of your national ID card or of your passport page where your photo is printed. For non-EU candidates: Copy of your passport page where your photo is printed. 2) Curriculum Vitae (may include hyperlinks to your ResearchID, Research Gate, Google Scholar accounts). 3) Detailed list of publications (may include hyperlinks to DOI of publications). 4) Letter of motivation relatively to the position (Cover Letter) (maximum 1 page) 5) Copy of your Master degree if already available. 6) Coordinates of reference persons (maximum 3): Title, Name, organization, e-mail. If you have questions regarding the application, you can contact the supervisor(s).