



Charles-Edouard Bréhier  
*From France to Sweden*



Project: Splitting schemes for stochastic FitzHugh–Nagumo systems

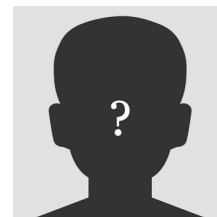
Research topic: Mathematics

Swedish Institution: Chalmers University of Technology, Gothenburg

French Institution: **Université de Pau et des Pays de l'Adour**

Dates of mobility: **05/10/2024 to 12/10/2024**

Program: SFVE-A



## PRESENTATION

[Charles-Edouard Bréhier](#) is Professor in the Mathematics department of Université de Pau et des Pays de l'Adour (France). His main research themes are analysis of numerical methods for stochastic partial differential equations and for multiscale stochastic systems, and applications of stochastic models in physics. He has obtained his PhD in Mathematics in 2012 in Rennes (France), and has been a CNRS Junior researcher in Lyon from 2015 to 2022.

He has many collaborators around the world, in particular [David Cohen](#) at Chalmers University of Technology in Gothenburg.

In the recent years, the applicant, Charles-Edouard Bréhier, and the host, David Cohen, have written articles on splitting and exponential integrators for several classes of stochastic partial differential equations.

## ACTIVITIES IN SWEDEN

The objective of the mobility period was to design, analyze and test original and efficient numerical schemes for a class of stochastic FitzHugh–Nagumo equations, which are models in neuroscience. The unknowns of the system are voltage and recovery variables. This was a continuation of a previous article written by the applicant and the host. During the mobility period, we have considered two variants of that system: instead of having additive space-time white noise in the evolution of the voltage variable, we have considered either additive space-time white noise or multiplicative time-dependent noise in the evolution of the recovery variable. We have

- constructed and implemented splitting schemes,
- performed preliminary numerical experiments,

- conjectured some rates of convergence,
- sketched the proofs of the some convergence results.

We have to face new interesting challenges in the analysis compared with our previous work. These results are expected to be published in research articles in the near future.

We have also spent some time on the preparation of an article, written in collaboration with a PhD student at Chalmers and a colleague from Universitat Autònoma Barcelona. This is a work where we analyze an exponential Euler scheme for stochastic partial differential equations driven by noise with Riesz covariance.

We have also discussed other ongoing or new research projects on numerical schemes for other stochastic partial differential equations systems, working on the codes, performing numerical experiments and writing preliminary ideas of proofs of convergence.

Charles-Edouard Bréhier has given a presentation on a recent research work on *Asymptotic error analysis of stochastic optimization schemes* for the Computational and Applied Mathematics seminar (organized by David Cohen) on Monday 07/10/2024.