Schedule and additional information for the Summer School

Numerical Methods for Stochastic Differential Equations

02-04 September 2013, Vienna University of Technology

The summer school aims to bring together talented young researchers in the field of (stochastic) differential equations and Computational Finance, mainly in their first PhD year. It is organized in the framework of the Marie-Curie Initial Training Network Novel Methods in Computational Finance (STRIKE) and the FWF Doctoral School Dissipation and Dispersion in Nonlinear Partial Differential Equations (nPDE). Support from these two projects as well as from the network Stochastic Modeling with Applications in Financial Markets is acknowledged.

1 Schedule

Registration starts on 02 September, 08:30–9:30h.

Location: Lecture room Hörsaal 6, second floor, green area, Wiedner Hauptstr. 8-10, 1040 Wien (see the maps at the end of the booklet).

<table>
<thead>
<tr>
<th>Time</th>
<th>Monday 02/09</th>
<th>Tuesday 03/09</th>
<th>Wednesday 04/09</th>
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<tbody>
<tr>
<td>08:45–09:00</td>
<td>Welcome</td>
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<td>09:00–10:00</td>
<td>A. Rößler 1</td>
<td>G. Lord 1</td>
<td>D. Higham 3</td>
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<tr>
<td>10:00–10:30</td>
<td>Coffee break</td>
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<td>Coffee break</td>
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<tr>
<td>10:30–11:00</td>
<td>C. Kühn</td>
<td>C. Kumar</td>
<td>L. Meinecke</td>
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<td>11:00–12:00</td>
<td>D. Higham 1</td>
<td>A. Rößler 2</td>
<td>G. Lord 3</td>
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<tr>
<td>12:00–13:30</td>
<td>Lunch break</td>
<td>Lunch break</td>
<td>Lunch break</td>
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<tr>
<td>13:30–14:30</td>
<td>E. Buckwar 1</td>
<td>G. Lord 2</td>
<td>E. Buckwar 3</td>
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<tr>
<td>14:30–15:30</td>
<td>D. Higham 2</td>
<td>E. Buckwar 2</td>
<td>A. Rößler 3</td>
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<tr>
<td>15:30–16:00</td>
<td>Coffee break</td>
<td>15:30–16:15 Coffee break &amp; poster</td>
<td>Coffee break</td>
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<tr>
<td>16:00–16:45</td>
<td>A. Lang</td>
<td>16:15–16:45 F. Delgado</td>
<td>P. Friz</td>
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<tr>
<td>16:45–17:30</td>
<td>J. Schoenmakers</td>
<td></td>
<td>Closing (~17:00)</td>
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2 Mini-courses

Evelyn Buckwar (Linz, Austria)
Stability theory for numerical methods for stochastic differential equations
Abstract: This course is concerned with the following topics: Linear stability theory, mean-square stability, almost sure stability, nonlinear stability results.

Desmond Higham (Strathclyde, United Kingdom)
Stochastic simulation in chemistry and finance
Abstract: (1) Gillespie/Tau leaping/Langevin for chemical kinetics; (2) multi-level Monte Carlo for Gillespie-style simulation; (3) simulating nonlinear SDEs in finance.

Gabriel Lord (Edinburgh, United Kingdom)
Stochastic PDEs and their numerical approximation
Abstract: The lectures will introduce space-time noise and consider Q-Wiener processes and the Ito stochastic integral for this case. We will examine mild solutions of a semilinear stochastic PDE, introduce numerical methods, discretising in both space and in time, and examine convergence. Throughout we will illustrate these concepts with simple numerical codes.

Andreas Rößler (Lübeck, Germany)
Introduction to weak and strong approximation methods for stochastic differential equations
Abstract: (1) Brief introduction to SDEs and Ito's formula, stochastic Taylor expansion, weak and strong approximation of solutions, Taylor schemes; (2) introduction to stochastic Runge-Kutta methods, rooted tree theory, weak and strong approximation schemes, order conditions, implementation issues; (3) the idea of multi-level Monte Carlo simulation with applications to mathematical finance
3 Invited Talks

Peter Friz (TU Berlin, Germany)
Rough path analysis
Abstract: We shall explain the basic ideas of rough path analysis and indicate their significance for weak and strong approximation schemes, both for SDEs and SPDEs.

Annika Lang (ETH Zürich, Switzerland)
Simulating the driving noise of a stochastic partial differential equation
Abstract: It is well-known that the simulation of the solution of a stochastic partial differential equation requires discretization in space and time. In this talk we observe that the implementation of these approximations might still cause problems since the simulation of the driving noise requires the generation of infinitely many random numbers. We introduce approximations of the driving noise and show that these do not dominate the overall convergence of the discretization scheme if the parameters are chosen appropriately.

John Schoenmakers (WIAS Berlin, Germany)
Simulation of conditional diffusions via forward-reverse stochastic representations
Abstract: In this talk we present stochastic representations for the finite dimensional distributions of a multidimensional diffusion on a fixed time interval, conditioned on the terminal state. The conditioning can be with respect to a fixed point or more generally with respect to some subset. The representations rely on a reverse process connected with the given (forward) diffusion as introduced in Milstein, Schoenmakers, Spokoiny (2004) in the context of a forward-reverse transition density estimator. The corresponding Monte Carlo estimators have essentially root-N accuracy, hence they do not suffer from the curse of dimensionality. This is joint work with Christian Bayer.
4 Contributed Talks

Francisco Delgado (Barcelona, Spain)
Approximation of a stochastic wave equation in dimension three, with application to a support theorem in Hölder norm

Christian Kühn (TU Wien, Austria)
Deterministic continuation of stochastic metastable equilibria via Lyapunov equations and ellipsoids

Chaman Kumar (Edinburgh, UK)
Numerical techniques for SDEs with random coefficients and jumps

Lina Meinecke (Uppsala, Sweden)
Stochastic simulation of diffusion via first exit times

5 Poster

Darina Graczova (Bratislava, Slovakia)
Dynamic accumulation model with fat-tailed distributed returns

Christof Heuer (Sussex, UK)
High-order compact finite difference schemes for option pricing in stochastic volatility models on non-uniform grids

Harald Hinterleitner (Linz, Austria)
Modelling with the stochastic neural field equation

Peter Schillen (Kaiserslautern, Germany)
The scalar Keller-Segel model on networks

Long Teng (Wuppertal, Germany)
A general approach for stochastic correlations using hyperbolic functions

Zuzana Zikova (Wuppertal, Germany)
Convergence model of interest rates

Magdalena Zitnanska (Bratislava, Slovakia)
Option pricing
6 Practical Information

From the airport to the Hotel Theresianum

There are three ways to go by public transport from the airport to the hotel:

- Take the local train (Schnellbahn, two zones, 4.20 Euro one way, every 30 min., travel time: 24 min.), leave the train at Wien Mitte (Landstraße), and take the subway U4 in the direction of Hüttdorf (included in ticket price), exit two stops later at Karlsplatz, take the subway U1 in the direction of Reumannplatz and leave two stops later at Südtiroler Platz. Walk the Favoritenstraße north until Favoritenstraße 52 where your hotel is located.

- Take the City Airport Train (17 Euro return ticket, every 30 min., travel time: 16 min.), leave the train at Wien Mitte (Landstraße), and take the subway U4 in the direction of Hüttdorf (ticket: Einzelfahrschein, 2 Euro), exit two stops later at Karlsplatz, take the subway U1 in the direction of Reumannplatz and leave two stops later at Südtiroler Platz. Walk the Favoritenstraße north until Favoritenstraße 52 where your hotel is located.

- Take the bus (Vienna Airport Line, about 13 Euro return ticket, every 30 min., travel time: 20 min.), leave at Schwedenplatz, take the subway U1 in the direction of Reumannplatz and leave 4 stops later at Südtiroler Platz. Walk the Favoritenstr. 52 where your hotel is located.

Hotel

AUSTRIA TREND HOTEL BEIM THERESIANUM
Address: Favoritenstraße 52, 1040 Wien
Tel.: +43/1/505 16 06
Fax: +43/1/505 16 09
e-mail: theresianum@austria-trend.at
www.austria-trend.at/Hotel-beim-Theresianum

Lecture room

Freihaus Hörsaal 6, second floor, green area, Wiedner Hauptstr. 8-10, 1040 Wien (see location plans below).

Internet connection

You will be able to use wireless internet connections at TU Wien. The networks tunet and eduroam are available.
To use *tunet*, please use an open authentication, deactivate data encryption, and automatic IP address and DNS server. You can login by opening any homepage; you will be directed to the page *Captive Portal* at which you can login using your personal user name and password written on the separate leaflet.

To use *eduroam*, you need to have an account set up at your home institution. Then you can simply login using the same credentials (username and password) that you would use at your home institution.

**Food**

Three cafeterias (Mensa Markt, Marktcafé and Cafe Schrödinger) are located in the Freihaus building close to the Hauptgebäude where the workshop is held.

On the first floor in the yellow aisle you find the Mensa Markt and the Marktcafé. The latter is open from 9.00 to 16.00. Breakfast, cold and warm beverages, pastry and snacks are served. The Mensa Markt is open from 11.00 to 14.30. You also may choose a menu. A non-alcoholic beverage is included in the menu. Or you can have a choice of soups, vegetables, grilled meat, a salad buffet, and a pastry buffet. Café Schrödinger: Opening hours from 8.00 to 19.00. You find it on the ground floor in the green aisle of the Freihaus.

In the vicinity of the Vienna University of Technology, there are quite a few bistros and small restaurants ranging from the typical Viennese to the exotic. Most of them are situated on the Naschmarkt, a few minutes walk to the west of the Freihaus building down Faulmanngasse.

- Gastwirtschaft am Rilkeplatz: Rilkeplatz 9, simple dishes
- Yamo-Yamo: Favoritenstrasse 2, Japanese type and Thai food (vegetarian options)
- Kebabhaus: Faulmanngasse 1, a variety of Turkish food.
- Chang Asian Duck: Rienböglasse 1, gourmet Chinese food (vegetarian options)
- There are many restaurants around Schleifmühlgasse and Naschmarkt.

A list with restaurants in the vicinity of the TU Wien can be found at http://www.fam.tuwien.ac.at/contact/restaurants.pdf.
How to go to the TU Wien from the Hotel beim Theresianum:
... by walking (1.5 km)

Subway station
Karlsplatz

Freihaus
(Wiedner Hauptstr. 8-10)
Here you find the secretary:
green zone, third floor,
room DA 03 K22

Hotel beim Theresianum
(Favoritenstr. 52, 1040 Wien)
Here you find your hotel.

Freihaus
(Wiedner Hauptstr. 8-10)
Here you find the lecture room
Hörsaal 6, green zone, second floor

... by subway (2 stations)

- Walk the Favoritenstr. south to the subway station Südtirolerplatz
- Buy a ticket for one trip (Einzelfahrt Vollpreis, 2 stations, 2,10 €) or a 24-Stundenticket
  (valid for 24 h, 7,10 €)
- Take a train in the direction of Leopoldau (comes every 5 min.), exit two stops later at Karlsplatz
- Take the station exit Resselpark, cross the park south and arrive at the main building
How to find the lecture room (Hörsaal 6)

Freihaus
Wiedner Hauptstr. 8-10,
1040 Wien

Hörsaal 6
Second floor, green zone