Introduction to ITN STRIKE

Models and Numerics in Financial Mathematics

Lorentz Center, Leiden, May 26–29, 2015

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STRIKE – Outline

1. Overview
   - Consortium
   - Highlights
   - History

2. Goals and Implementation

3. Summary of Outcomes

4. Follow up Success / Long lasting Effects

5. Fellows and Secondments

6. Events

7. Computational Finance Toolbox
Marie Curie Initial Training Networks 2012 (ITN)

- **Multi-Partner ITNs (Multi-ITN)**
  at least 3 participants established in at least 3 different Member States

- Participation of **private sector** at the highest possible level is encouraged

- **Associated partners** can also complement the training programme

- EU contribution: recruitment of a maximum of **500 researcher months**

- **Participants (level 1)**
  recruiting and employing eligible researchers, providing specialised research and transferable skills training, also secondment opportunities

- **Associated Partners (level 2)** (located in any country)
  do not recruit any researchers, but provide research and transferable skills training and/or secondment opportunities

- **Duration** of project is normally 48 months
  - Early Stage Researcher (ESR) 3–36 months
  - Experienced Researcher (ER) 3–24 months
FP7-PEOPLE-2012-ITN STRIKE – Overview

- maximum EU contribution of 3,582,470.98 € and 492 researcher months
  - 12 ESRs (PhD students, 36 months funding each)
  - 5 ERs (PostDocs, 12 months funding each)
- 11 Beneficiaries, 10 Associated Partners (3 universities, 4 SMEs, 1 Bank)
- many conferences, schools, compact courses, workshops, etc.

May 25–29, 2015, itn-strike.eu
STRIKE – Consortium Beneficiaries

- BU Wuppertal (Prof. Matthias Ehrhardt)
- CU Bratislava (Prof. Daniel Sevcovic)
- UP Valencia (Prof. Lucas Jódar Sánchez)
- U Rousse (Prof. Lyuben G. Vulkov)
- ISEG Lisboa (Prof. Maria do Rosario Lourenço Grossinho)
- UA Zittau (Prof. Ljudmila Bordag)
- TU Wien (Prof. Ansgar Jüngel)
- TU Delft (Prof. Kees Oosterlee)
- U Greenwich (Prof. Choi-Hong Lai)
- U Würzburg (Prof. Alfio Borzi)
- U Antwerp (Prof. Karel in ’t Hout)
STRIKE – Consortium
Associated Partners

- Université Paris VI (Prof. Olivier Pironneau)
- University of Sussex (Dr. Bertram Düring)
- University of A Coruña (Prof. Carlos Vázquez Cendón)
- MathFinance AG (Prof. Uwe Wystup)
- d-fine GmbH (Dr. Bodo Huckestein)
- Postbank AG (Dr. Jörg Kienitz)
- NAG - The Numerical Algorithms Group (Dr. François Cassier)
- MathConsult GmbH (Dr. Andreas Binder)
- Stichting Centrum Wiskunde & Informatica (CWI Amsterdam)
  (Prof. Kees Oosterlee & Mr. Dick Broekhuis)
- Yandex (Dr. Pavel Serdyukov)
STRIKE – Consortium

External Partners

- Deloitte & Touche GmbH (Dr. Thomas Siwik & Dr. Manuel Wittke), Financial Risk Solutions, FSI Assurance, Düsseldorf
- Sachsen Asset Management, Leipzig
- Ortec Finance (Dr. Hens Steehouwer), Risk & Return Management, Rotterdam
- ING Bank (Dr. Marc van Balen and Dr. Drona Kandhai), Corporate Market Risk Management, Amsterdam
- Rabobank (Dr. Sacha van Weeren), Modelling & Research, Utrecht

Cooperating Networks

- Scientific Research Community STOCHMODFIN - Stochastic Modelling with Applications in Financial Markets (Ghent University, Belgium)
- ITN HPCFinance – Training in Modern Quantitative Methods and High-Performance Computing for Finance (TU Tampere, Finland)
STRIKE – Highlights – Posters from Tuesday

Introduction to ITN STRIKE

created by ESR 1 and ESR 2

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itn-strike.eu
STRIKE – Highlights

- offer very broad scope of scientific knowledge from Lie-groups, analysis ... to ... GPU computing, case studies
- accomplished with a wide range of complementary training Risk Management, Grant writing, social awareness,...(see WP5)
- innovative topics (selection)
  - Kinetic Methods in Modelling Financial Markets (WP 1)
  - Modelling with nonlinear BS eqs, Lie group analysis (WP 1)
  - Mixed Analytical-Numerical Methods (WP 1,2)
  - Semi-Lagrangian Schemes in Finance (WP 2)
  - Fast Solver for optimal control problems in finance (WP 3)
  - Unbiased MC Methods for Interest Rate Models (WPs 3,4)
  - Model Order Reduction for Financial Models (WPs 3,4)
  - GPU Computing in Finance (WPs 3,4)
  - Fourier Methods in Calibration (WP 4)
STRIKE – History

- story started with editing a book on nonlinear Black-Scholes Equations

- first submission January 2011 (result C)

- Workshop Lorentz Center, Leiden April 2011
  Workshop Quantitative Methods in Financial and Insurance Mathematics

- second try submitted January 2012
  - June 2012, result B: 2nd place among 16 submissions in MATH panel
  - we have already started 2nd re-submission

- Sep 25, 2012, ”Invitation to negotiations of proposal no 304617 – acronym STRIKE”
STRIKE – The Kick-Off, March 2013
STRIKE – The last 2 years ...

- new associated partners were found quickly
  MathConsult, NAG, Deloitte, Yandex
- also joint activities with partner ITN HPCFINANCE
  e.g. young researchers’ minisymposium at ECMI 2014
- and joint activities with dutch-flamish partner network STOCHMODFIN
  e.g. Summer School Numerics of SDEs, Vienna
- small delays in recruitment, visa issues with Non-EU residents
- ESR 10 (Greenwich) resigned and was substituted
- Dr. Kienitz moved from Postbank to Deloitte (substitution installed)
- we passed very successfully the mid-term review in Sep/Oct 2014
Goals and Implementation
**STRIKE – Goals**

- we want to train the whole working cycle:
  - Modelling, Analysis Numerics, Implementation, case studies
- this is reflected by the choice of the 4 WPs
  - accomplished with training of highly relevant transferable skills
  - interconnected basket of research and training tasks

<table>
<thead>
<tr>
<th>State-of-the-Art</th>
<th>Planned ITN STRIKE Network Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>banks use standard tree approaches or linear BS models in practice</td>
<td>nonlinear BS equations and kinetic herding &amp; contagion models are used in European banks (WP 1)</td>
</tr>
<tr>
<td>banks use standard FDMs for solving linear BS models in practice</td>
<td>most modern, high-order, compact FDMs for nonlinear BS equations are used in European banks (WP 2)</td>
</tr>
<tr>
<td>banks and institutions introduce counteractions without any mathematical basis</td>
<td>Optimal Control Tools allow European banks and institutions to design properly counteractions (WP 2,3)</td>
</tr>
<tr>
<td>classical sequential programming (only BNP Paribas uses GPU codes)</td>
<td>GPU programming (order of magnitudes faster and energy efficient) used regularly in banks (WP 3)</td>
</tr>
<tr>
<td>Reduced Basis Methods is a newly emerging topic in computational finance</td>
<td>nonlinear MOR Tools in banks allow for efficient and robust control of stochastic parameters (WP 3)</td>
</tr>
<tr>
<td>standard practice: calibration &amp; validation using linear BS equations</td>
<td>Fast calibration &amp; validation using nonlinear BS models and novel fast Fourier methods (WP 4)</td>
</tr>
<tr>
<td>standard numerical PDE solvers are used, CFD codes not known in banks</td>
<td>CFD codes, e.g. OpenFOAM, contain advanced pricing/calibration libraries used in banks (WP 2,3,4)</td>
</tr>
</tbody>
</table>
STRIKE – Implementation

STRIKE
Novel Methods in Computational Finance

- Novel nonlinear and kinetic Models of Financial Markets
- Innovative Ideas in Scientific Computing
- Modern Techniques of Discretization and Numerical Analysis
- State-of-the-art Calibration Methods
- Transferable Skills and Social Awareness

Close Academic and Private Sector Partnership

Dissemination
Research
Training
Impact

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STRIKE – Implementation

- **project structure**, using the Research & Training Board and the Supervisory Board has been implemented

- individual projects have been cast into four **scientific Work Packages**
  1. Modelling and Analysis
  2. Numerical Methods for Nonlinear Models
  3. Scientific Computing
  4. Validation and Calibration

- trans-national training programme based on **4 complementary elements**
  1. Research Project, involving original research
  2. Structured Training in math. finance, analysis, numerical methods
  4. Transferable Skills Training:
     - scientific, management and communication skills

- Fellows co-operate in various Tasks and regularly exchange information, including with staff from other Research Teams / Associated Partners
Summary of Outcomes
Summary of Outcomes – Scientific Advances

■ publications
  in total: 62 publications (ESRs are already involved in 18 pubs) (ESRs are installed since 12–14 months in average)
  ESR1 (5), ESR2 (2). ESR4 (3), ESR7 (4), ESR12 (5)

■ 94 public presentations of research team members / fellows
  ESR1 (5), ESR2 (2), ESR3 (6), ESR4 (2), ESR5 (4), ESR6 (6), ESR7 (4), ESR8 (2), ESR9 (1), ESR11 (1), ESR12 (5)
  ER1 (2), ER4 (1)
  ■ 2 talks of ESR7 chosen as best talk of conferences 2013, 2014 (≈1000 participants)

■ more details in scientific WPs 1–4 ...
Summary of Outcomes – Recruitment

- During the first year **all 12 ESRs were appointed** (36 month contracts)
- ESR 10 left prematurely; an appointment of a new ESR was made shortly
- ER 4 (1-year contract) was already appointed quite early in the project, who, after one year, immediately found a next job at RABOBANK
- ER 1 (Wuppertal) will start October 1.
- 3 additional ER vacancies have to be filled in the next periods
  - advertisements of vacancies will be published on EURAXESS
- recruitment procedure caused some delays (on average 4 months)
  - However, because it applies to quite a number of Fellows, it not immediately influences cooperation in a negative way.
- Initially, a gender balance of at least 40% females was achieved (now 30%)
- Personal Career and Development Plan (PCDP) defined for each fellow:
  - regularly evaluated (at least yearly) and updated
  - planning of secondments to partners has been made
Summary of Outcomes – First Progress

- **first Progress Meeting for the Fellows** Valencia in September 2013

- **first outcomes from the Research Projects** were presented within a series of Minisymposia on Computational Finance at ECMI 2014, the 18th European Conference on Mathematics for Industry, Taormina, Sicily, June 2014

- at the same occasion a **young researchers’ minisymposium High Performance Computational Finance** jointly with ITN HPCFINANCE was organized by ESR 2

- **further outcomes of the ESR Projects** were presented at the STRIKE Summer School on Financial Mathematics at Conference Mathematical Methods in Economy and Industry (MMEI2014), Smolenice, Slovakia
Summary of Outcomes – Dissemination

- **Dissemination** generated at more conferences, workshops and seminars.
- The Research Teams from STRIKE did provide more than 90 presentations at public events – in 40 of them by the Fellows.
- Research Teams from STRIKE did generate more than 60 publications in which, already after roughly one year, Fellows were involved in 18 of these.
- Work did result in **several press-releases** at start and during the project.
Summary of Outcomes – Training Activities

- **The Training activities are monitored** in a Work Package ”Transferable Skills Training”. In Year 1 already three main events have been organized.

- Events cover mathematics needed in modelling / numerical simulation:
  - financial modelling, Lie-Algebra techniques, stochastic equations, nonlinear solution techniques and GPU-programming.

- A broader range of Transferable Skills covered topics like:
  - presentation techniques, ethics and social awareness and social responsibility in finance and economics, multi-cultural management and IPR.

- At the Postbank Workshop, Associated Partners gave several presentations on topics at their companies.
  - Apart from practical use of methods and specific problems, this also provided insight into future career options.
STRIKE – Follow up Success

- Lisbon could contract one more ESR-FCT (Yaser Kord) as satellite member (financed by the Portuguese Foundation for Science and Technology)
- Ms. Dr. Marta Pou Bueno (ER4, Delft) found a job at RaboBank, starting SEP 2014
- SEP 2014 granted European Industrial Doctorates (MSCA-ITN-2014-EID) WAKE-UP CALL on Market Risk (Delft, A Coruña, Bologna, 6 PhD positions)
- SEP 2014 granted European Joint Doctorates (MSCA-ITN-2014-EJD) HPC–LEAP on High Performance Computing (Wuppertal is beneficiary, 2 PhD positions)
STRIKE – Long lasting Effects

- Installation of **Special Interest Group (SIG)** in ECMI framework
  ECMI SIG can also become an activity of an Alumni Group
- upcoming reports in **ECMI news 2014** on STRIKE ESR projects
- **ERASMUS**, e.g. Wuppertal–A Coruña, Wuppertal–Bratislava
- **new bilateral agreements**
  e.g. Wuppertal–A Coruña (DAAD), Lisbon–Bratislava, etc.
- **new related network proposals**, e.g.
  - successful proposal for Workshop at Lorentz Center (Delft & Antwerp)
  - successful MSCA-ITN-2014-EID proposal (Delft & A Coruña)
  - proposal DAAD thematic network on energy markets (Oct. 2014)
    (Wuppertal, Sussex, A Coruña, Delft & Antwerp)
  - successful proposal Bulgarian Research Academy on Airpollution
    problems (July 2014, Ruse & Wuppertal)

General Idea: take a STRIKE related topic, use a subset of the consortium
  e.g. HPC, Risk Control, Energy Markets, Big Data (Yandex, Zittau), ...
- we started a **conference series** with Int. Conference Greenwich Dec. 2015
Fellows and Secondments
STRIKE = Fellows + Supervisors
STRIKE – ESR Fellows

- ESR 1: Ms. Zuzana Zikova (Wuppertal, Sept 2013)
- ESR 2: Mr. Jose Pedro Campos Moreira da Silva (Wuppertal, July 2013)
- ESR 3: Mr. Pedro Polvora (Bratislava, Sept 2013)
- ESR 4: Ms. Vera Egorova (Valencia, Sept 2013)
- ESR 5: Mr. Walter Mudzimbabwe (Rousse, Dec 2013)
- ESR 6: Mr. Nicola Cantarutti (Lisbon, July 2013)
- ESR 7: Mr. Ivan Yamshchikov (Zittau, Feb 2013)
- ESR 8: Ms. Lara Trussardi (Vienna, June 2013)
- ESR 9: Mr. Alvaro Leitao Rodríguez (Delft, Sept 2013)
- ESR 10: Ms. Ton Nu Huong Giang Hoang (Greenwich, 9/2013 – 2/2014)
- ESR 10: Mr. Shih-Hau Tan (Greenwich, July 2014)
- ESR 11: Ms. Beatrice Gaviraghi (Würzburg, Apr 2013)
- ESR 12: Mr. Radoslav Vulkov (Antwerp, Nov 2013)
STRIKE – ER Fellows

- **ER 1:** Mr. Dr. Christof Heuer (Wuppertal, Oct. 2014)
- **ER 2:** Ms. Dr. Silvie Kafková (Bratislava, Oct. 2015)
- **ER 3:** ??? (Valencia)
- **ER 4:** Ms. Dr. Marta Pou Bueno (Delft, Oct. 2013–Aug 2014)
- **ER 5:** ??? (Greenwich)

- 5 years ER rule difficult to meet and 12 months of contract not attractive: be very flexible with the starting date once you have a suitable candidate.
# STRIKE – Secondments

<table>
<thead>
<tr>
<th>Fellow</th>
<th>Secondment to</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESR1</td>
<td>CU Bratislava (2015)</td>
</tr>
<tr>
<td>ESR3</td>
<td>BU Wuppertal (2015)</td>
</tr>
<tr>
<td>ESR4</td>
<td>U A Coruña (2015)</td>
</tr>
<tr>
<td>ESR5</td>
<td>BU Wuppertal</td>
</tr>
<tr>
<td>ESR6</td>
<td>U Würzburg(2015)</td>
</tr>
<tr>
<td>ESR7</td>
<td>Yandex (Berlin location, 2015)</td>
</tr>
<tr>
<td>ESR8</td>
<td>U Sussex (2014/2015), U Paris VI</td>
</tr>
<tr>
<td>ESR9</td>
<td>U A Coruña</td>
</tr>
<tr>
<td>ESR10</td>
<td>CU Bratislava, TUD</td>
</tr>
<tr>
<td>ESR11</td>
<td>TU Delft (&amp; CWI Amsterdam, 2015)</td>
</tr>
<tr>
<td>ESR12</td>
<td>TU Delft (&amp; CWI Amsterdam, 2015)</td>
</tr>
</tbody>
</table>

- planned in the individual PCDP plans of each ESR / ER
- reviewed by the RTB, guaranteeing that the local specialist can plan his practical involvement and that an activity fits the local interests
STRIKE – Events

Introduction to ITN STRIKE
STRIKE – Events

... also the events are structured (explaining the non-chronological ordering)

<table>
<thead>
<tr>
<th>No</th>
<th>Main Training Events &amp; Conferences</th>
<th>Work Package</th>
<th>Lead Institution</th>
<th>Project Month (estimated)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>* Kick-Off Workshop</td>
<td>all</td>
<td>Wuppertal</td>
<td>~ 2</td>
</tr>
<tr>
<td></td>
<td><strong>Training Phase 1: Learning and Training</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Compact Course Lie Group Methods</td>
<td>1,2</td>
<td>Zittau</td>
<td>~ 7</td>
</tr>
<tr>
<td>3</td>
<td>Compact Course GPU Computing / OpenFOAM</td>
<td>2,3,4</td>
<td>Delft</td>
<td>~ 10</td>
</tr>
<tr>
<td>4</td>
<td>Summer School</td>
<td>1,2,3</td>
<td>Vienna</td>
<td>~ 11</td>
</tr>
<tr>
<td>5</td>
<td>Winter School</td>
<td>2,3,4</td>
<td>Greenwich</td>
<td>~ 15</td>
</tr>
<tr>
<td>6</td>
<td>* Summer School</td>
<td>1,2</td>
<td>Bratislava</td>
<td>~ 23</td>
</tr>
<tr>
<td>7</td>
<td>* Summer School</td>
<td>2,3,4</td>
<td>Delft</td>
<td>~ 35</td>
</tr>
<tr>
<td></td>
<td><strong>Training Phase 2: Progress and First Results</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>* Progress Workshop, Jornadas</td>
<td>all</td>
<td>Valencia</td>
<td>~ 12</td>
</tr>
<tr>
<td>9</td>
<td>* Postbank Workshop</td>
<td>2,3,4</td>
<td>Bonn</td>
<td>~ 17</td>
</tr>
<tr>
<td>10</td>
<td>* Summer Meeting</td>
<td>all</td>
<td>Lisbon</td>
<td>~ 21</td>
</tr>
<tr>
<td>11</td>
<td>Minisymposia at Algorithmy Conference</td>
<td>2,3</td>
<td>Bratislava</td>
<td>~ 32</td>
</tr>
<tr>
<td></td>
<td><strong>Training Phase 3: Presentation and Publication</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>6th Workshop Nonlinear PDEs and Financial Math.</td>
<td>1,2</td>
<td>Zittau</td>
<td>~ 19</td>
</tr>
<tr>
<td>13</td>
<td>Minisymposia ECMI 2014</td>
<td>2,3,4</td>
<td>Wuppertal</td>
<td>~ 22</td>
</tr>
<tr>
<td>14</td>
<td>Mini Workshop Optimization &amp; Control</td>
<td>3,4</td>
<td>Würzburg</td>
<td>~ 27</td>
</tr>
<tr>
<td>15</td>
<td>Minisymposia at MathFinance Conference</td>
<td>2,3,4</td>
<td>Frankfurt</td>
<td>~ 30</td>
</tr>
<tr>
<td>16</td>
<td>International Conference</td>
<td>1,2,3,4</td>
<td>Rousse</td>
<td>~ 33</td>
</tr>
<tr>
<td>17</td>
<td>International Conference</td>
<td>1,2,3,4</td>
<td>Greenwich</td>
<td>~ 42</td>
</tr>
<tr>
<td>18</td>
<td>* Closing Meeting</td>
<td>all</td>
<td>Antwerp</td>
<td>48</td>
</tr>
</tbody>
</table>
### STRIKE – Coverage Table on Events

#### Coverage Table Participation of Fellows in Events

| Fellow       | EV1  | EV4  | EV8  | EV2  | EV5  | EV3  | EV9  | EV13 | EV6  | EV14 | EV15 | EV11 | EV16 | EV10 | EV7  | EV17 | EV18 | Reasons of Absence |
|--------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------------------|
| ESR1 Zuzana  | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | -     |
| ESR2 José    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | -     |
| ESR3 Pedro   | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | -     |
| ESR4 Vera    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | -     |
| ESR5 Walter  | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | -     |
| ESR6 Nicola  | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | -     |
| ESR7 Ivan    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | -     |
| ESR8 Lara    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | -     |
| ESR9 Alvaro  | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | -     |
| ESR10 Giang/ Shih-Hau | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | -     |
| ESR11 Beatrice | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | -     |
| ESR12 Radoslav | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | -     |

- Mean that each Fellow will receive sufficient Training
- "+" means attended; "o" means not planned; "p" means planned (from PCDP)

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**Introduction to ITN STRIKE**
STRIKE – Planning of upcoming Events

Event07 Workshop Models and Numerics in Financial Math., Leiden, NL, May 26-29

STRIKE RTB Meeting, July 8

ICCF 2017 will be in Lisbon and ICCF 2019 in Wuppertal
STRIKE SB Meeting, Dec 16 http://iccf.eu


Event18 Closing Meeting, Antwerp, December 2016

- note: secondments can have an impact on participation of events
STRIKE – Summary

- the consortium performed as a network
- offered a broad range of (complementary) training
- disseminated a high number of publications
- some (minor) problems were resolved quickly
- started already with “long lasting” actions: ICCF, SIG
- first follow up success did show up
- finally, a vital, homogeneous group of fellows
Computational Finance Toolbox
Christof Heuer (ER1, Wuppertal)

- collection of codes provided by the ESRs
- unified and graphical user interface by Dr. C. Heuer
- still seeking for an SME that might take care of the CFT