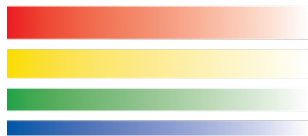


# NETADIS Mid-Term Review Co-ordinator's Report

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**NETADIS**  
Statistical Physics Approaches  
to  
Networks Across Disciplines



# Outline

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# Recruitment of 12 ESRs

- Positions **advertised widely** to attract best candidates: www.findaphd.com, jobs.ac.uk, Euroaxess, Nature Jobs, ...
- Candidates made aware of all positions, encouraged to **apply to more than one institution**
- Local ranking on academic excellence and fit to proposed ESR project(s)
- Candidates with multiple applications also asked to rank institutions
- **Global optimization of assignment** of ESRs to institutions, to maximize number of first preferences
- Assignment circulated to consortium & approved

# Gender balance and geographical distribution

- 149 applicants overall, **30% female**
- Recruitment strategy (Annex I): “preference for female applicants at equal qualification”
- Fully implemented: final cohort with **7 females out of 12**
- **Equal opportunities** aim (Annex III) fully met
- Distinctly **international** group of ESRs recruited
- Home institutions in France, Italy, Germany, India, Armenia, Argentina
- ESRs started work in Sept 2012 (or late 2012 / Jan 2013 for Italian partners)

# Application statistics

Site	Advertising methods	Advertising period	Applicants	% Female	% non-EU
King's College	Euraxess, King's Maths Dept Website, Jobs.ac.uk, www.findaphd.com	27/01 – 15/03/2012	45	25%	40%
CNRS ENS	Euraxess, PI's personal webpage, laboratory webpage	7 weeks	17	29%	23%
CNRS Orsay	LPTMS and Euraxess	27/01 – 15/03/2012	19	47%	26%
TUB	Euraxess	08/02 – 15/03/12	17	35%	42%
Torino	Euraxess, www.findaphd.com	20/02 – 30/06/2012	7	28%	28%
Rome	Email, Netadis website	6 weeks	4	50%	50%
NTNU	jobs.ac.uk, Euroaxess, NTNU Kavli Inst. website	6 weeks	14	28%	42%
KTH	Euraxess, Nature Jobs, KTH website	6 weeks	10	10%	30%
ICTP	Euraxess, www.findaphd.com	27/01 – 15/03/2012	16	18%	43%
<b>Totals</b>			<b>149</b>	<b>30%</b>	<b>36%</b>

# Changes since initial recruitment

- ESR recruited to ICTP Trieste, **did not renew contract** in Aug 2013
- **In-depth conversations** held with co-ordinator and Prof. Kühn (also KCL)
- ESR offered period of reflection w. possibility of return in Oct 2013
- Declined in the end
- **Replacement recruited** in Nov 2013:  
6-month contract, existing collaborator of Marsili
- Future recruitment to ICTP to be discussed at MTR, possibly joint supervision with NTNU Trondheim

# Project manager

- Pascale Searle appointed at start of project
- Considerable expertise of ITN management under Framework 7 and previous framework programmes



# Constitutional meeting

- Administrative kick-off, held in London, April 2012
- Constituted network **sub-boards**:
  - Career Development board
  - Education board
  - Dissemination board
- Constituted **supervisory (main) board**
- Sollich elected chair, Leuzzi deputy chair
- **Regular board meetings** since then:
  - Torino Feb 2013, Hillerod Sept 2013
- Minutes circulated for amendment and approval; action points

# Outline

# Scientific kick-off

- Torino Feb 2013
- Closed meeting as planned, to allow group cohesion to build
- **ESR representatives** elected and appointed (Bravi & Tyagi)
- **All ESRs presented** work to date, and draft **career development plan**
- **Tutorial introductions** from senior NETADIS academics to application areas and research themes
- 1 day of **presentation skills** training, delivered by private sector partner Medialab: good feedback from ESRs
- **Career Development Board** discussed draft plans, suggested amendments
- Plans circulated and approved post-meeting

- Part of **International Master's in Physics of Complex Systems**
- Held in Trieste May/June 2013
- All ESRs attended as planned (Annex I)
- Topics:
  - Spin Glasses, Structural Glasses and Information Theory (Silvio Franz)
  - Advanced Methods of Stochastic Dynamics (Ken Sekimoto)
  - Non-Equilibrium Statistical Mechanics of Bio-Polymers (Christian Micheletti and Giovanni Bussi)
  - Machine Learning, Inference, Optimization and Control (Bert Kappen)

# First NETADIS summer school

- Hillerod (Denmark), **two weeks** in Sept 2013
- Attended by all ESRs, **open** to others, widely advertised
- Number of **bursaries** offered to participants without funding to **maximize benefits to community**
- 44 participants, including from Iran and Turkey
- Lively poster sessions, split to facilitate interaction
- Complementary skills training on **entrepreneurship and exploitation of research results**
- Delivered by private sector partner Capital Fund Management

# Summer school lectures

- Graph Theory (Remi Monasson)
- Metabolic Networks (Enzo Marinari)
- Random Matrices (Pierpaolo Vivo)
- Statistical Inference (Manfred Opper)
- Statistical Modelling of Sequences (Martin Weigt)
- Neural Coding (John Hertz)
- Disordered Systems – Statics (Luca Leuzzi)
- Disordered Systems – Dynamics (Yasser Roudi)
- Synaptic Plasticity (Mark van Rossum)
- Reinforcement Learning (Remi Munos)
- Finance (Jean-Philippe Bouchaud)

# Co-sponsored School

- Les Houches, France, Sept/Oct 2013
- Topic: **Statistical physics, Optimization, Inference and Message-Passing algorithms**
- Attended by a number of ESRs
- **Co-sponsored** by NETADIS because of direct relevance to ongoing and planned work

## Local training & external conferences

- **Local courses**, e.g. at London Taught Course Centre
- Conference “Stability of the Banking Sector”
- Winter School “Quantitative System Biology”
- Workshop “Complex Networks: Structure and Dynamics”
- Programme “Stochastic Thermodynamics”
- Conference “Statistical Mechanics of Biological Cooperativity”
- Summer school “Fundamental Problems in Statistical Physics”
- Conference “Statistical Physics & Inf. Proc. in Biology”
- “3<sup>rd</sup> Cross-Disc. Genomics Symposium Biological Networks”
- **Transferrable skills** courses  
(e.g. on academic writing, information retrieval strategies)
- Teaching experience e.g. from tutorial work



# Secondments programme

- ESRs spend ca. 2 months with project partner (different methods or application domain)
- Implemented as planned: all ESRs have undertaken **first secondment**, or will very shortly
- Secondment periods **staggered between June 2013 and March 2014**, to ensure seconded ESRs can work with local ESRs
- Planning for **second secondment**: under way
- Candidate destinations already identified

# Future network meetings

- **Second NETADIS summer school** planned for Cortona, July 2014
- Retreat format to allow maximal time for collaborative work among ESRs and NETADIS academics
- Several **smaller workshops** in planning, e.g. “Modelling and inference for network dynamics”, Stockholm, June 2014
- ESRs involved in meeting organization and management decisions, e.g. search for venue for second summer school
- Feedback from ESRs sought systematically, led e.g. to change of format for Cortona

# Involvement of private sector partners in training

- **Medialab & Capital Fund Management** have delivered complementary skills training
- Secondment with CFM (as second secondment for ESR Paga) in planning for 2014
- **Collegio Carlo Alberto** hosted first secondment of Paga
- ESR Feinauer's project is in close collaboration with **Human Genetics Foundation**

# Outline

- Initial priority
- Set up with advice and input from private sector partner Medialab
- Content headings:
  - **About** (What is NETADIS, Background, Research Areas, Partners)
  - **Researchers and projects** (biographical and scientific information on each ESR and their project)
  - **Presentations and reports**
  - **News and events** (NETADIS-organized & other relevant)
  - **Publications**
  - **Outreach section**

# Outreach via electronic fora

- NETADIS [website outreach section](#)
- List of expertise for outreach and consultancy of science leads at all project partners
- Lecture slides for communicating NETADIS ideas to the public
- Background material suitable for journalists and teachers
- NETADIS [facebook page](#), set up by ESRs
- Communication platform
- Announcements of news and events

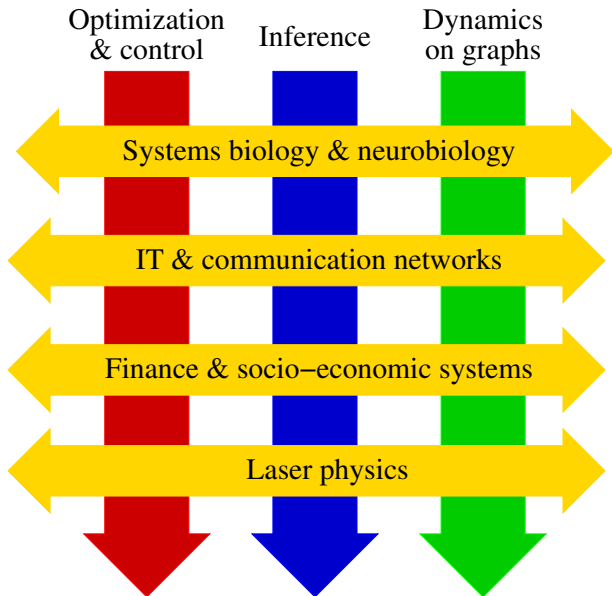
- Dissemination of NETADIS work as training resource for worldwide audience
- Engaged staff from videlectures.net to record and publish lectures from Hillerod summer school
- **Audio, video and slides** in synchronized and easily navigated format
- Suitable for broad audience

## Other outreach

- Contributions to **local outreach** events
- E.g. widening participation events
- Talks at student weekend conferences
- Seminars for taster days for pre-university school students
- Kavli Community Symposium
- Italian Institute of Culture talk here on Wed
- NETADIS feed-in to **white paper** on Big Data research policy
- Digital Horizons workshop organized by The Economist
- **Public workshops** in Stockholm
- One-month **research programme** at KITP China in 2014: dissemination and network opportunities with Chinese academic community.



# Outline



- **4.1** *Effects of surrounding network on sub-network dynamics in protein interaction networks*

Projection methods w. quadratic memory terms describe real network dynamics very accurately; now extending to extrinsic noise effects (Bravi)

- **4.4** *Inference of contacts in proteins, applications to protein folding*

Substantial technical review on inference by evolutionary information, paper on a Gaussian model for protein contact inference (Feinauer)

- **4.6** *Reconstruction of molecular networks from genomic data*

Related work into inference of evolutionary structures in influenza viruses (Grigolon), controlling intrinsic transcriptional noise in regulation networks (Martirosyan)

- **5.1** *Message-passing approach to non-equilibrium steady states of networked IT and communication systems*  
Related work on projection formalism in non-equilibrium spin dynamics, with assessment of projection quality (del Ferraro)
- **5.2** *Scalable decentralized optimisation and control for heterogeneous networked IT systems*  
Work on node and edge disjoint path optimization methods that minimize both path length and traffic congestion (de Baco)
- **Aston University** (U.K.) added as **associated network partner** for this WP and WP8

- **6.1** *Analysis of illiquidity and market impact in Minority Games*

Simulations of idealized financial networks in models of varying complexity (Paga), related work on agent-based simulation of resource allocation game (Feinauer)

- **6.3** *Algorithm for finding a minimal set of nodes for viral marketing on a given graph*

Work ongoing on epidemic diffusion on graphs, minimal initial conditions to contaminate (or market to) whole graph, conjecture on size of minimal set (Guggiola)

- **7.1** *Numerical simulation of random lasing systems in 3D with GPU optimized algorithms with varying geometry and interaction network of light modes*

Ongoing baseline studies into simplified models (XY models on Bethe/Erdos-Renyi bipartite graphs) to understand coherent light emission on laser networks (Tyagi)

# Optimization and control (WP8)

- **8.1** *Message passing algorithms for optimisation under dynamic and non-equilibrium conditions*

Baseline work ongoing for the static optimization task (WP5.2)

- **8.3** *Analytical results on minimal fraction of initially infected nodes for avalanche contamination*

Ongoing related work on minimal fraction for contamination of entire graph (WP6.4)

- **9.1** *Mean-field methods for inferring parameters of Generalized Linear Models and Ising models*  
Closely linked to WP10.1 below (Bachschnid Romano; Battistin)
- **9.2** *Test of inference approximations on smaller toy problems*  
Dynamical mean field theory for kinetic Ising models (Bachschnid Romano), extension to networks of stochastic differential equations (Bravi)
- **9.6** *Inference of real distribution of random couplings from experimental correlations among light intensity spectra and mode phases*  
Ongoing work on inference approaches to estimating interaction of localized models in linear systems (Tyagi)



- **10.1** *Dynamical functional approach for Bayesian inference of stochastic dynamics*

Inference of unobserved variables from trajectories of observed variables (Bachschmid Romano)

Variational approximations for non-equilibrium networks from path integral formulation for kinetic Ising model (Battistin)

- **10.3** *Projected equations of motion for sub-networks of protein interaction networks*

Equations found from both projection method & Gaussian variational approach, insights into distinction internal vs. external noise (Bravi)

Related work on dynamical processes in cellular networks: pattern formation for floral morphogenesis (Grigolon), optimal resolution for description of dynamics of complex systems (Haimovici)