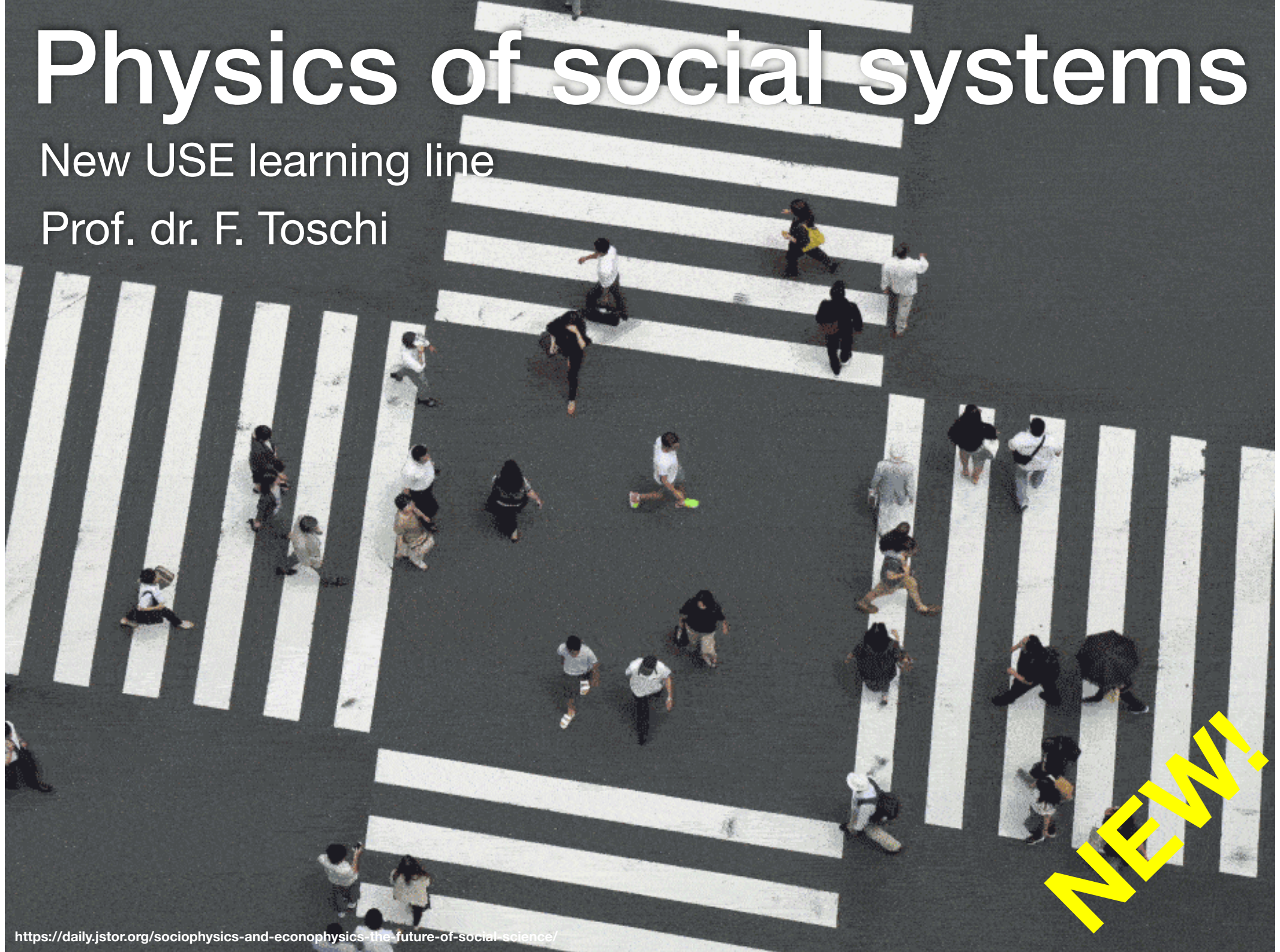


Physics of social systems

New USE learning line

Prof. dr. F. Toschi



NEW!

A new USE learning line

- **Challenge Based Learning (CBL):** *from teaching to learning, matching TU/e 2030 vision for education*
- Intrinsically **multidisciplinary challenges:** *alpha, beta, gamma*
- **Education and research:** *hand in hand*

Sociophysics (examples)

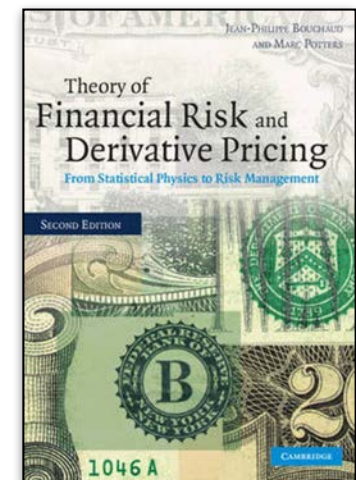
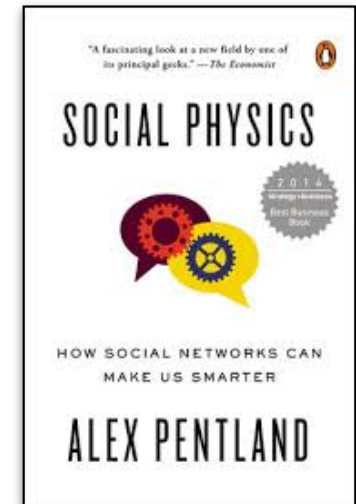
“**Social physics** or **sociophysics** is a field of science which uses mathematical tools inspired by physics to understand the behavior of human crowds. In a modern commercial use, it can also refer to the analysis of social phenomena with big data.”

Source Wikipedia

- Spreading of diseases (Ebola, Coronavirus, ...)
- Spreading of opinions (Facebook–Cambridge Analytica,...)
- Econophysics (stock exchange, cryptocurrencies,...)
- **Crowd dynamics** (urban infrastructures, ...)
- ...



2020/21



Stakeholder **ProRail**



Key questions

- **How to observe a social system?**

Sociophysics 1

- **How to model a social system?**

Sociophysics 2

- **How to nudge a social system?**

Sociophysics 3

NIAS
Lorentz center
Workshop @Oort

Physics and Psychology of Human Crowd Dynamics
5 - 9 November 2018, Leiden, the Netherlands

Venlo-Viersen
Werkzaamheden L/m
businzel

Scientific Organizers

- Alessandro Corbetta, TU Eindhoven
- John Drury, University of Sussex
- Enrico Ronchi, Lund University
- Federico Toschi, TU Eindhoven
- Armin Seyfried, FZ Jülich

Topics

- **Crowd Sensing**
pedestrian big-data acquisition techniques
- **Crowd Analytics**
statistical data processing & modeling
- **Crowd Understanding**
theory connecting physical & psychological variables
- **Crowd Applications**
knowledge transfer to/from technology & safety

The Lorentz Center organizes international workshops for researchers in all scientific disciplines. Its aim is to create an atmosphere of intense collaborative work, discussion and interaction. For registration see: www.lorentzcenter.nl

The workshop is part of the NIAS-Lorentz Program, to stimulate research bridging the natural sciences with the Humanities and social sciences.

Poster design: Superflux Studio, NL

Universiteit Leiden
NWO
NIAS
Lorentz center

www.lorentzcenter.nl

A multidisciplinary science

| | Mathematics / physics | Machine learning | Psychology | Ethic |
|-----------------------------------|-----------------------|------------------|------------|-------|
| Sociophysics 1 | ✓ | ✓ | ✓ | ✓ |
| How to observe the social system? | | | | |
| Sociophysics 2 | ✓ | ✓ | ✓ | ✓ |
| How to model the social system? | | | | |
| Sociophysics 3 | ✓ | ✓ | ✓ | ✓ |
| How to nudge the social system? | | | | |

A multidisciplinary team



Federico Toschi
Physics



Antal Haans
Psychology



Wybo Houkes
Philosophy & Ethics



Alessandro Corbetta
Physics



Yvonne de Kort
Psychology



Gunter Bombaerts
Ethics



Vlado Menkovski
Machine learning



Frank vd Schadewijk
Crowdmanagement specialist

+ TAs (PhD or MSc students)

The format

- **3 courses** (5 ECTS each): students must follow them one after the other, preferably in year 2 (quarters 1, 2 and 3)
- Work on a **single project** that spans **over the 3 courses**
- In course 1 emphasis on “*How to observe a social system?*”
- In course 2 emphasis on “*How to model a social system?*”
- In course 3 emphasis on “*How to influence a social system?*”
- **Basic lectures** at beginning of course(s) (namely course 1).

The format

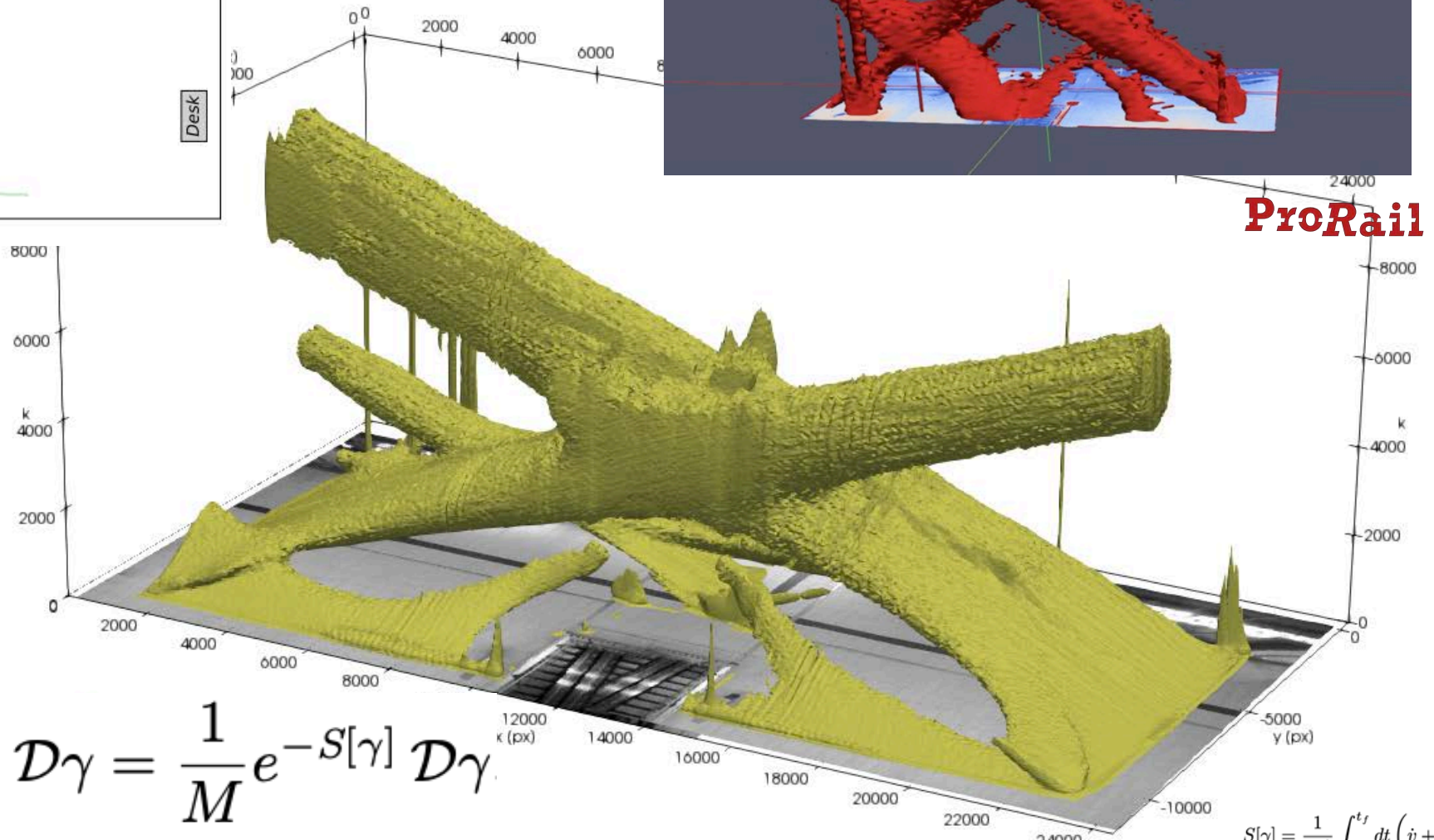
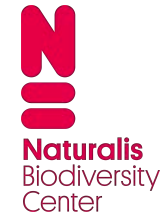
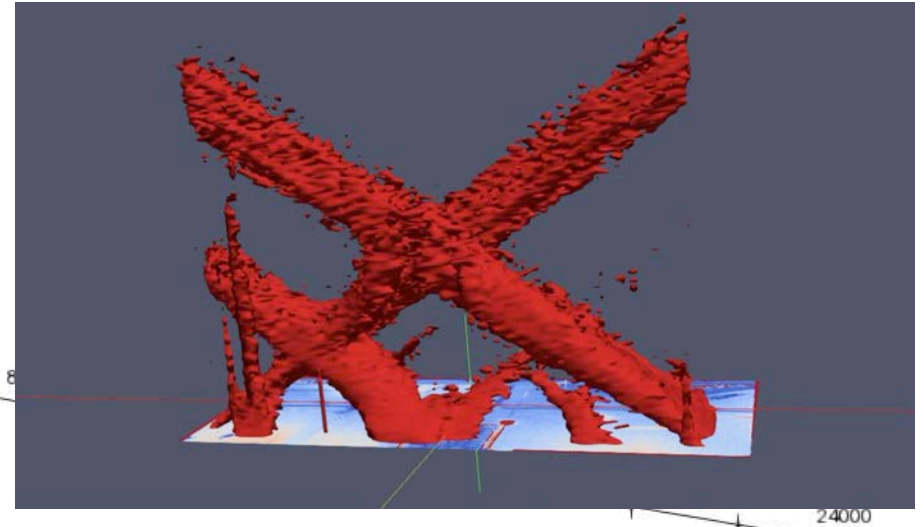
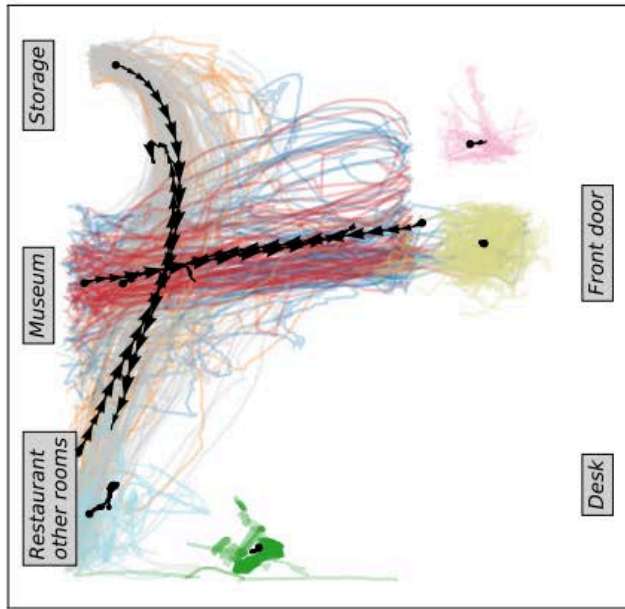
- **Students work in groups** of 4
- **Admission** to the USE learning line **requires an application**, with a motivation letter. Students will be selected.
- **Groups are heterogenous**, groups define their project(s) and ambition(s)
- In year 2020/21 we start with a **cap of 36 students** (9 groups), 3 TAs (supervising 3 groups each)
- Students will analyse **real-life data**, will **develop models** and will **perform experiments**
- **Eindhoven centraal station** and/or Strijp-S will be flagged as “**experimental**” to facilitate students experiments

The format

At the end of the course(s):

- Students **present a poster** (weight 15%)
- Students deliver **a group report** (weight 60%)
- Students **peer-grade** their work in groups (weight 10%)
- Students **give a presentation** to the Stakeholder(s) and lecturer(s) (weight 15%)

Education and research hand in hand



$$d\mathbb{P}[\gamma] = \rho[\gamma] \mathcal{D}\gamma = \frac{1}{M} e^{-S[\gamma]} \mathcal{D}\gamma$$

$$S[\gamma] = \frac{1}{\epsilon} \int_0^{t_f} dt \left(\dot{x}^2 + \dot{y}^2 + \dot{z}^2 \right)$$

In the future

- Connection with multidisciplinary research
- Evaluation of the first year(s)...
- Involve more lecturers (open platform): cover different disciplines
- Introduce more topics (at least one academic leader and one stakeholder), e.g.:
 - *Spreading of diseases*
 - *Spreading of opinions*
 - *Econophysics*
 - ...

