WG2 Machine learning for low frequency seismology

COST ACTION CA17137
A NETWORK FOR GRAVITATIONAL WAVES, GEOPHYSICS AND MACHINE LEARNING

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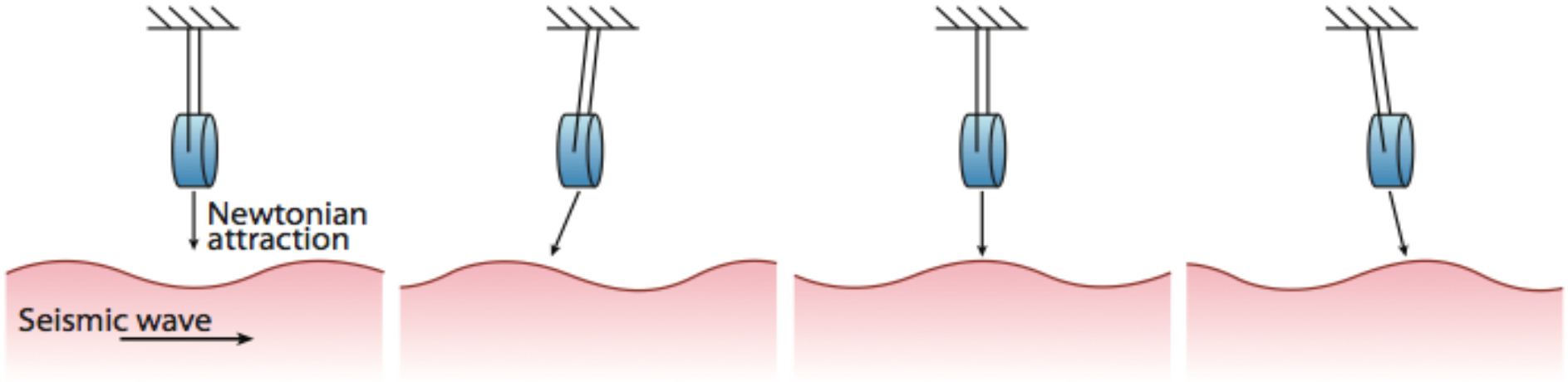
WG2 - Countries and institutes interested … so far

1. **Finland** (University of Helsinki, Abo Akademi University Turku)
2. **France** (Institut de Physique du Globe Paris)
3. **Greece** (Aristotle University of Thessaloniki)
4. **Hungary** (Wigner RCP Budapest)
5. **Italy** (Scuola Superiore S. Anna Pisa, INGV Pisa)
6. **Malta** (University of Malta)
7. **Poland** (University of Warsaw, Polish Academy of Sciences)
8. **Serbia** (Mathematical Institute SASA, Belgrade)
9. **Netherlands** (Nikhef, Amsterdam)
10. **United Kingdom** (University of Southampton)

WG2 focus – Newtonian noise on GW detectors

atmospheric

seismic



Gravitational coupling between the mirrors and surrounding mass density fluctuations

WG2 focus – Newtonian noise on GW detectors

Challenges:

- NN cannot be distinguished from GWs and cannot be shielded

Expectations about NN:

- To be limiting the reach of next generation detectors in the low frequency (2-20 Hz) band
- To be observable in the existing instruments in bad weather conditions

Current approach:

1. Deploy arrays of environmental (seismic and pressure) sensors around the test masses to reconstruct the NN field

2. Subtract its effect from the GW channel by means of an optimal (static) Wiener filter

WG2 objectives

Bringing the NN challenge to a new level by involving expertise outside GW physics

ML for seismic field modeling and NN field reconstruction:

- wave propagation characteristics
- noise stationarity and time evolution
- design of optimized sensor arrays

Robotics for adaptive arrays of environmental sensors

Complementary to WG3

WG2 objectives

Interdiscpilinary research topics (check out MoU):

Seismology:

•earthquacke waveforms, seismic array intereferometry, Newtoian noise analysis

Signal processing:

•match-filtering, Wiener filtering, deconvolution

Mathematical modeling:

•Bayesian analysis, Markov chains, Fokker-Planck and Langevine equations

Machine learning for robotics:

•deep learning, reinforcment learning, Belief space planning

Gravitational waves detection:

•instrumentation, hardware and data processing

Organization

WG2 tasks (preliminary):

- Gravitational waves detectors instrumentation
- Robotics
- Seismology: hardware and data processing
- Applied mathematics

…group is still being formed...

This week:

- Task list will be finalized
- Task leaders will be appointed

Everyone interested in WG2 is invited to attend tomorrow morning group meeting and contribute to the open discussion

Today's session

1. *Tomasz Bulik (Warsaw University/Virgo)* - ***Newtonian Noise subtraction test array at Virgo***
2. *Fabio Bonsignorio (Scuola Superiore Sant'Anna)* - ***Robots for GW detectors and infrastructure monitoring and operation: Can Networks of Autonomous Robotics Vehicles help the characterization of Newtonian, Acoustic and Other Source Noise in GW detection?***
3. *Jozinović Dario (INGV, Roma)* - ***Machine Learning for seismic events***
4. *Soumen Koley (Nikhef, Netherland)*-***GW detector sites characterization with seismic arrays***
5. *Dr Velimir Ilic (MISASA, Serbia)* - ***Generalized maximum entropy inference for seismic models***

Enjoy!