J. Garnier (Université Paris VII)

Papers and preprints on `http://www.proba.jussieu.fr/~garnier`

- Stochastic analysis, multi-scale analysis.
- Waves in random media, in particular

- time reversal for waves in complex media,
- competition between randomness, dispersion, and nonlinearity for wave propagation phenomena (optical solitons, dispersion-managed solitons, and Bose Einstein condensates).

- Hydrodynamic instabilities.
- Stochastic algorithms.

- Main collaborators on waves:

J.-P. Fouque (UC Santa Barbara): 3D randomly layered media,
A. Nachbin (IMPA, Rio): gravity waves over rough seabed (tsunami),
G. Papanicolaou (Stanford): waveguide + imaging problems (active time-reversal, passive time-reversal by cross-correlation),
K. Sølna (UC Irvine): waveguide + paraxial waves.

Random waveguides

• Propagation (forward scattering approximation) and time reversal in random waveguides (rather well understood).

• Beyond the forward scattering approximation: take into account backscattering.

• Enhanced backscattering: the mean reflected intensity is (twice) larger in the backscattered direction than in the other directions.

• Physical proof using diagrammatic expansions.

• Experimental observations (in optics, acoustics, ...).

• Mathematical proof in a particular asymptotic regime in J. Garnier et K. Solna, Effective transport equations and enhanced backscattering in random waveguides, submitted.

• But: no numerical simulations (2D full wave).
+ Investigate statistical stability (we know it is not stable).

Randomly layered media and surface waves

• Propagation and time reversal of waves propagating *through* the layers (rather well understood, equivalent to 1D).

• Also well known:

1) Consider two homogeneous half-spaces, with indices $n_{up} > n_{do}$.

2) Send a down-going but oblique plane wave from above, with angle θ_{up} compared to the normal.

3) Descartes says: the transmitted plane wave has an angle θ_{do} such that $n_{do} \sin \theta_{do} = n_{up} \sin \theta_{up}$.

4) Therefore: if $n_{do} = n_{up} \sin \theta_{up}$, then $\theta_{do} = \pi/2$, i.e. the "transmitted" wave should be a surface wave.

Question: what happens in a random medium ?

Nothing has ever been done (by mathematicians) with surface waves in random media !

Randomly layered media could be a starting point.

Remark: Geophysicists are very fond of surface waves and give them names: Rayleigh waves, Love waves, ...