

# Traditional and invisible composites: R-linear problem and its applications

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**Timetable:** 8 hours. First lecture on July 22, 2016, 10:00 (following lectures will be agreed with the teacher), Torre Archimede, Room 2BC/30.

**Course requirements:** No special requirement is needed for this course. Only some fundamental knowledge of calculus and introductory knowledge of complex analysis.

**Examination and grading:** Grading is based on an oral examination.

**SSD:** MAT/05

**Aim:** The aim of the lectures is to introduce PhD students to some recent researches in applied mathematics devoted to composites; to provide them the method of complex potentials and constructive homogenization based on asymptotic analysis; to introduce PhD students to recent mathematical study of invisible materials. These lectures are intended to students and researchers in pure and applied mathematics and in scientific computing (symbolic computations).

## Course contents:

Statement of the  $\mathbb{R}$ -linear problem and its relations to the classic boundary value problems. Riemann-Hilbert problem.

Application to composites. Constructive homogenization.

Representative volume element.

Asymptotic methods to calculate the effective constants.

Schwarz's alternating method and functional equations.

Implementation of the method and symbolic-numerical computations.

Mathematical foundations of invisible materials.

## References

- [1] O'Neill, J., Selsil, Ö., McPhedran, R.C., Movchan, A.B., Movchan, N.V. (2015) Active cloaking of inclusions for flexural waves in thin elastic plates *Q J Mechanics Appl Math*, doi:10.1093/qjmam/hbv007.
- [2] Mityushev V., Rogosin S. *Constructive Methods for Linear and Nonlinear Boundary Value Problems for Analytic Functions. Theory and Applications*, Chapman & Hall / CRC, Monographs and Surveys in Pure and Applied Mathematics, Boca Raton, 2000, 283 pp.
- [3] Mityushev V., Nawalaniec W. Basic sums and their random dynamic changes in description of microstructure of 2D composites, *Computational Materials Science, Computational Materials Science*, 97, (2015) 64-74.
- [4] [en.wikipedia.org/wiki/Metamaterial\\_cloaking](http://en.wikipedia.org/wiki/Metamaterial_cloaking)
- [5] [wolfram.com/index.php](http://wolfram.com/index.php) Mathematica