Homogenisation of fractional diffusion problems

Andreas Buchinger, Krešimir Burazin, Ivana Crnjac, Marko Erceg, Maja Jolić and Marcus Waurick

Fractional differential operators have become an important tool for modelling nonlocal phenomena, including anomalous diffusion, image processing, and continuum mechanics models such as peridynamics. We study homogenisation of fractional divergence form diffusion problems with highly oscillatory coefficients. We characterise the convergence of these coefficients in terms of two classical notions of convergence: H-convergence, describing the local behaviour of the operator, and weak-$*$ convergence, accounting for the nonlocal effects induced by the fractional structure. We further establish several fundamental properties of this convergence, including uniqueness of limits, metrisability, energy convergence. Moreover, we analyse the limiting regimes of finite-horizon fractional diffusion problems.

First Author: Andreas, Buchinger
Affiliation: *Technische Universität Hamburg, 21073, Germany*
e-mail: andreas.buchinger@tuhh.de

Second Author: Krešimir, Burazin
Affiliation: *School of Applied Mathematics and Informatics, J.J. Strossmayer University of Osijek, 31000, Croatia*
e-mail: kburazin@mathos.hr

Third Author: Ivana, Crnjac
Affiliation: *School of Applied Mathematics and Informatics, J.J. Strossmayer University of Osijek, 31000, Croatia*
e-mail: icrnjac@mathos.hr

Fourth Author: Marko, Erceg
Affiliation: *Department of Mathematics, Faculty of Science, University of Zagreb, 10000, Croatia*
e-mail: maerceg@math.hr

Fifth Author: Maja, Jolić
Affiliation: *School of Applied Mathematics and Informatics, J.J. Strossmayer University of Osijek, 31000, Croatia*
e-mail: mjolic@mathos.hr

Sixth Author: Marcus, Waurick
Affiliation: *TU Bergakademie Freiberg, 09599, Germany*
e-mail: marcus.waurick@math.tu-freiberg.de