A TEMPORAL MULTISCALE METHOD FOR A SYSTEM OF DIFFERENTIAL EQUATIONS WITH FRACTIONAL DERIVATIVES

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PING LIN*, ZHAOYANG WANG

ABSTRACT

We first study a nonlinear system of fractional ordinary differential equations with multiple scales in time, where the fast system has a periodic applied force and the slow system contains fractional derivatives. A local periodic equation is derived to approximate the microscopic behaviour of the original system and then the fast variable with microscopic feature in each macro-step can be solved effectively and independently. We analyse the approximate error and show that the resulting coupled micro-macro multiscale method can largely save the long-term computational time through a number of numerical examples. Finally we extend the method and analysis to a 2D atherosclerosis model where its plaque growth may be with memory.

* Division of Mathematics, University of Dundee, p.lin@dundee.ac.uk