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MULTISCALE QUASICONTINUUM APPROACHES FOR DISCRETE MODELS OF FIBROUS MATERIALS SUCH AS ELECTRONIC TEXTILE AND PAPER MATERIALS

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The multiscale quasicontinuum (QC) method was proposed to reduce the computational costs of atomistic lattice calculations [1] and is able to capture individual mechanical lattice events in regions of interest, whilst it coarse-grains the discrete model elsewhere. Recently, it has been shown that the method cannot only be used for conservative (mostly atomistic) lattice computations [1,2], but also for non-conservative lattice computations [3,4], introducing entirely new application fields to the method which will be demonstrated in this presentation. To guarantee that dissipative lattice models can be incorporated, the QC approach is formulated in terms of the virtual-power of the lattice model [3,4]. This has been shown for lattice models with dissipative interactions [3] and dissipative bonds [4], which are for instance useful to mechanically describe electronic textile [3,5] and paper materials [4,6]. Current research focuses on developing QC strategies for beam lattices [7], as all previous QC methods can only deal with (non-linear) springs. It is expected that this will increase the applicability of QC approaches to discrete mechanical models of fibrous materials even further.

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REFERENCES

[1] Tadmor EB, Philips R, Ortiz M, 1996, Mixed atomistics and continuum models of deformation in solids, Langmuir 12, 4529-4534.

[2] Beex LAA, Peerlings RHJ, Geers MGD, 2011, A quasicontinuum methodology for

multiscale analyses of discrete microstructural models, International Journal for Numerical Methods in Engineering 87, 701-718.

[3] Beex LAA, Peerlings RHJ, Geers MGD, A multiscale quasicontinuum methodology for dissipative lattice models and discrete networks, Journal of the Mechanics and Physics of Solids, In press (http://dx.doi.org/10.1016/j.jmps.2013.11.010).

[4] Beex LAA, Peerlings RHJ, Geers MGD, 2014, A multiscale quasicontinuum methodology for lattice models with bond failure and fiber sliding, Computer Methods in Applied Mechanics and Engineering 269, 108-122.

[5] Beex LAA, Verberne CW, Peerlings RHJ, 2013, Experimental identification of a lattice model for woven fabics: application to electronic textile, Composites Part A 48, 82-92.

[6] Wilbrink DV, Beex LAA, Peerlings RHJ, 2013, A discrete network model for bond failure and frictional sliding in fibrous materials, International Journal of Solids and Structures 50, 1354-1363.

[7] Beex LAA, Kerfriden P, Rabczuk T, Bordas SPA, Quasicontinuum-based multiscale approaches for plate-like beam lattices experiencing in-plane and out-of-plane deformation, Submitted to Computer Methods in Applied Mechanics and Engineering.