Towards robust and high-fidelity paper sheet modelling

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ABSTRACT

Paper, consisting of an underlying fibrous network, is notably susceptible to deformations due to variations in moisture content. Wetting and drying at the fibre level may result in significant deformation, which propagates to the level of the sheet. Sheet level deformations due to changes in moisture content are practically relevant, e.g. in water-based inkjet printing.

The multi-scale nature of paper requires understanding the behaviour at the fibre level in order to explain the deformations, due to changing moisture content at the sheet level. Therefore, it is important to understand, predict and control such behaviour with a multi-scale view of paper.

The objectives of this study are modelling the hygro-mechanical response of paper by incorporating features of a complex network of fibres and subsequently simulating the multi-scale problem with smallest and largest relevant scales being the fibre diameter and sheet size.

The meso-scale model developed by the research group incorporates relevant features of the fibre network like geometry, anisotropy of the fibre distribution, different roles played by the free-standing fibre segments and the bond regions in hygro-expansion. To explain the irreversible hygroscopic strains in restrained dried paper, a homogenized macro-scale model accounting for the irreversible behaviour needs to be developed, for analysing the role of physical mechanisms like fibre activation and micro-compression.

REFERENCES

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