Thermodynamics and homogenisation theory as driving forces in the design of novel experiments and the (re-)evaluation of data

Univ.-Prof. Dipl.-Ing. Dr. techn. Hellmich, TU Wien

There is broad consensus that theories may profit, or may essentially be built, on appropriate experiments. There is also broad consensus that experiments and theory, together, are the key fundaments of modern natural sciences.

However, it is also important to remember that practically speaking, it is often not so much the theory which builds on experiments, but it is the "choice of (theoretical) problems“ which actually drives the experimental design [1]: In this sense, it was BECAUSE Kepler wished to find a theoretically harmonious solution to astronomical problems, he TESTED, based on then known astronomical „experimental“ observations, the significance of the ellipse as the path followed by the planets.

In the context of experimental mechanics, we will discuss, in the lecture, two lines along which theoretical (and computational) methods can boost the significance of experimental methods:
(i) massive re-evaluation of multi technique data from a multi-theoretical, truly unifying, approach;
(ii) design of mechanical tests considering thermodynamics principles

Concerning (i) the lecture will cover a unified, mechanics-informed structural biology vision of mineralised tissues [2-5], integrating data from mechanical tests, ultrasonics, chemical analysis, light and electron microscopy, as well as small energy X-ray scattering; and concerning (ii) the lecture will cover the „true“, i.e. rate-independent elasticity of cementitious materials, to be clearly distinguished from their creep characteristics with characteristic time ranging from minutes to decades [6-8].

References:

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