**Emulating Body Tissue Architectures for**

**Computer-controlled Smart Material Design and Manufacture**

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Natural tissues such as the periosteum, the hyperelastic sheath covering all nonarticular surfaces of bone, exhibit smart properties1-3; *i.e.* they make bone stronger under high impact loads but resilient under lower impact loads with high cycle numbers. The awe-inspiring natural feat of using a "soft sheath" to confer extra strength to "hard bones" under high impact loads is pure genius, albeit not trivial to emulate or replicate on the lab bench. Here, for the first time to our knowledge, we precisely map the intrinsic weave of elastin and elastin in the periosteal sheath of the sheep femur. We render and scale up these natural patterns to create patterns using weaving algorithms, and thus enabling creation of the world's first physical textile swatches emulating the body's own. The resulting smart materials lend themselves for a variety of implantable medical devices. Coupled multiscale imaging and modeling are key to the success of this design and manufacturing paradigm.

1.     Ng J. *et al.*., Nature *Scientific Reports*, 2017, 7, 40396.

2.     McBride S.H. *et al.* *Journal of Biomechanics*, 2011, 44, 1954-9.

3.     McBride S.H. *el al.* *Annals of Biomedical Engineering*, 2011, 39, 1570-158.