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The advent of several Advanced Manufacturing (AM) methods has renewed the interest in lattice materials in view of their emerging role in several applications ranging from structural to thermal and electronic. The main difference between the AM-produced lattice materials and other known cases such as metallic foams, honeycombs etc is their programmable manufacturing capability that can be implemented at several length scales and with many variations. However, such manufacturing progress has created a new set of challenges to characterize and model the constitutive response of such materials. In fact, AM-produced 3D lattice materials can be viewed as composites of space and matter or as the reinforcement phase in examples of e.g. polymer resins. In this framework, this talk focuses on knitted textiles which are viewed as 3D lattice materials. Modern knitting machines are capable of providing control over the manufacturing process and as a result a variety of multiscale structures have been reported. Using knitted textiles as a working example, the talk presents an Integrated Computer Materials Engineering (ICME) approach to investigate the effect of their 3D architecture in their mechanical behavior. To achieve this goal, the built architecture is morphologically, topologically and geometrically characterized using imaging methods ranging from microscopy to X-ray computer tomography. In addition to such properties, the development of measurement methods for such porous and flexible materials is reported including imaging methods capable to *in situ* observe local kinematics and kinetics and relate them to behavior at higher length scales. Such parametrization, microstructure representations and mechanical performance data are subsequently used as inputs to 3D Finite Element Analysis (FEA) in which yarns and interfaces are directly accounted. Given the geometrical details of the entangled yarns included in the 3D models developed, parallelized Direct Numerical Simulations (DNS) run in a high performance computing environment using several numerical methods are shown to be capable of investigating the influence of local architecture at the yarn level including both loop geometry and knitting pattern on their mechanical behavior. The type and role of contact points as well as the influence of 3D kinematics on the computed mechanical properties are investigated. In addition, ways to reduce the computational cost and to use such DNS in multiscale homogenization methods are presented. Generalizations of the presented approach to other examples of 3D lattice materials are also shown.