SPACE-TIME MULTISCALE-MULTIPHYSICS COMPUTATIONAL TECHNIQUES

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In this talk I will describe an adaptive multiscale-multiphysics based design framework aimed at predicting the behavior of structural systems with strong spatial-temporal scale mixing and significant interaction of physical processes. The term multiscale-multiphysics based design framework is coined to emphasize that the behavior of the structure is assessed from the first principles, which are operative at smaller scales than currently resolved in simulations. A number of important applications fall into this category including: 3D woven architectures in aircraft engines, advanced airframes, tires, micro-electronic devices, and porous engineering materials such as honeycombs and truss-like materials. In these structures the size of the microstructure is comparable to that of structural details or to the wavelength of a traveling signal often leading to strong dispersion effects. This is further complicated by the fact that various physical processes, such as deformation, heat conduction, oxidation, stress corrosion, fatigue and fracture are operating at different spatial and temporal scales. The technical challenge is to use modern computing to develop new design concepts where material and structure are viewed as a single system.