Structure-preserving discretization of continuum theories

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In this talk I will describe several discrete models of infinite dimensional systems which preserve underlying geometric structures. Discrete models of this type usually lead to novel numerical methods, so called structure-preserving integrators, which capture the dynamics of the system without energy or momenta loss and preserve momentum maps in the discrete realm. This work started with development of the first variational integrator for Euler fluids. Since then, our methods have been developed further and are now applicable to a great variety of infinite-dimensional systems, such as magnetohydrodynamics or complex fluids. I will discuss our new approach to discretization based on ideas of noncommutative geometry. One of the goals of this work is creating a new model of discrete differential geometry that leads to a structure preserving discretization of general relativity.