Abstract: Geometry is at the foundation of many physical theories, even if it is often obfuscated by their formulations in vectorial or tensorial notations. When computational simulation is needed, leveraging geometric formulations of physical models can potentially lead to numerical methods with exact preservation of momenta arising from symmetries, good long-term energy behavior, and robustness with respect to the spatial and temporal resolution — only if one can preserve some of the most defining continuous structures in the numerical realm. In this talk, we will review a number of structure-preserving discretizations of space and time, from discrete counterparts of differential forms and symmetric tensors on surfaces, to finite-dimensional approximation to the diffeomorphism group and its Lie algebra. A variety of applications (from masonry to magnetohydrodynamics) will be used throughout the talk to demonstrate the value of a geometric approach to computations.

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