

16.1: Introduction

Lagrangian and Hamiltonian mechanics have been used to determine the equations of motion for discrete systems having a finite number of discrete variables q_i where $1 \leq i \leq n$. There are important classes of systems where it is more convenient to treat the system as being continuous. For example, the interatomic spacing in solids is a few $10^{-10}m$ which is negligible compared with the size of typical macroscopic, three-dimensional solid objects. As a consequence, for wavelengths much greater than the atomic spacing in solids, it is useful to treat macroscopic crystalline lattice systems as continuous three-dimensional uniform solids, rather than as three-dimensional discrete lattice chains. Fluid and gas dynamics are other examples of continuous mechanical systems. Another important class of continuous systems involves the theory of fields, such as electromagnetic fields. Lagrangian and Hamiltonian mechanics of the continua extend classical mechanics into the advanced topic of field theory. This chapter goes beyond the scope of a typical undergraduate classical mechanics course in order to provide a brief glimpse of how Lagrangian and Hamiltonian mechanics can underlie advanced and important aspects of the mechanics of the continua, including field theory.



Figure 16.1.1: Rubber bands are one type of elastic solid that can be described with continuous formalism. (CC BY-SA 3.0; [Bill Ebbesen](#))

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