

# Part I. Background and the Problem Setting

The purpose of this first part is to provide background from those parts of geometric mechanics that are needed in the remainder of the book. The first chapter contains background on regular symplectic reduction and includes all the proofs of the main theorems, such as point reduction, coadjoint orbits and orbit reduction. It also gives an overview of related research topics in geometric mechanics.

The second chapter starts with a review, again including proofs, of connections on principal bundles, including curvature. This is needed background for one of the important constructions for the book, namely cotangent bundle reduction, whose reduced spaces involves non-canonical symplectic structures, namely magnetic, or curvature terms. The chapter also gives the problem setting and explains why reduction by stages is relatively routine in the Poisson setting, while being quite nontrivial in the symplectic setting. The chapter ends with a survey and discussion of various applications, related areas and future directions, such as swimming fish, loop groups, the Bott-Virasoro group, and multisymplectic geometry.

As explained in the preface, the book assumes that the reader is familiar with the essentials of geometric mechanics, up to, but not including symplectic reduction theory; this background is given in, for example, [MandS] (see the abbreviation code for the major references in the preface). Of course people with a strong background in geometric mechanics can proceed directly to Part II.