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## Preface

The aim of this monograph is to give an overview of various classes of infinite-dimensional Lie groups and their applications, mostly in Hamiltonian mechanics, fluid dynamics, integrable systems, and complex geometry. We have chosen to present the unifying ideas of the theory by concentrating on specific types and examples of infinite-dimensional Lie groups. Of course, the selection of the topics is largely influenced by the taste of the authors, but we hope that this selection is wide enough to describe various phenomena arising in the geometry of infinite-dimensional Lie groups and to convince the reader that they are appealing objects to study from both purely mathematical and more applied points of view. This book can be thought of as complementary to the existing more algebraic treatments, in particular, those covering the structure and representation theory of infinite-dimensional Lie algebras, as well as to more analytic ones developing calculus on infinite-dimensional manifolds.

This monograph originated from advanced graduate courses and mini-courses on infinite-dimensional groups and gauge theory given by the first author at the University of Toronto, at the CIRM in Marseille, and at the Ecole Polytechnique in Paris in 2001–2004. It is based on various classical and recent results that have shaped this newly emerged part of infinite-dimensional geometry and group theory.

Our intention was to make the book concise, relatively self-contained, and useful in a graduate course. For this reason, throughout the text, we have included a large number of problems, ranging from simple exercises to open questions. At the end of each section we provide bibliographical notes, trying to make the literature guide more comprehensive, in an attempt to bring the interested reader in contact with some of the most recent developments in this exciting subject, the geometry of infinite-dimensional groups. We hope that this book will be useful to both students and researchers in Lie theory, geometry, and Hamiltonian systems.

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