Calculus of Variations

Mechanics, Control, and Other Applications

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Library of Congress information

This book is dedicated to my wife Ann.

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Preface

About this book

This book is aimed at the junior or senior-level student of mathematics, science, and engineering. It can also be used as an amusing summer course for graduate students by a judicious use of the starred exercises and proofs. Chapters 1–7 form a leisurely undergraduate semester course.

The difficulty of the book ramps up gradually — Chapter 8 is at a strong senior level, while Chapters 9 and 10 (Weak and Strong Sufficiency) and Chapter 11 (Corner Points) are more abstract and at very strong senior or graduate level.

The charm of this subject is found in its classical applications accessible to any student with calculus. We have attempted to downplay (at first) the technical details, to instead develop technique. As a result, even a modestly equipped student can carry away a strong understanding of the subject based on practice with the calculations. The starred proofs employ advanced machinery, but are sketched in an expository style that may be comprehensible to undergraduates. It is our belief that such exposure entices students into advanced study.

Why this book?

There is no modern text at this level that is accessible to students armed only with calculus. There are of course the fine classic Dover editions of Fox, Sagan, Weinstock, Ewing, and Gelfand/Fomin. But these books are all showing their age, and, unlike our book, none of these incorporate a simple introduction to optimal control, bang-bang, Pontryagin's maximum principle, or LQ control design. Some of the most entertaining applications of the calculus of variations are found in optimal control.

To the instructor

At times much of the detail is thrown into the Exercises. This is to facilitate flow and better display the attractive big picture. You may include some of these solutions in your lectures or assign them in some proportion consonant with your degree of commitment to the Moore system. A disk of solutions is available upon request.

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