

Preface

This is a book about continuous time optimal control and its extension to a certain class of dynamic games known as open loop differential Nash games. Its intended audience is students and researchers wishing to model and compute in continuous time. The presentation is meant to be accessible to a wide audience. Accordingly, the presentation does not always rest on the most general and least restrictive regularity assumptions.

This book may be used by those with little mathematical preparation beyond introductory differential and integral calculus and a first course in ordinary differential equations. Nonetheless, prior exposure to nonlinear programming is desirable. For those without that prior exposure, a chapter that reviews the foundations of NLP is included.

The exercises at the end of each chapter should be attempted by anyone seeking mastery of the material emphasized in this book. The exercises are in some cases very challenging, yet they accurately represent the kinds of problems one faces in building and applying dynamic models based on optimal control theory and dynamic non-cooperative game theory.

Chapter 1 provides some insight into the history of dynamic optimization and differential games, as well as a preview of the applications that are covered in the book. Chapter 2 provides a review of finite dimensional nonlinear programming, while Chapters 3 and 4 present the foundations of continuous time optimal control and infinite dimensional mathematical programming. Chapter 5 provides a condensed treatment of finite dimensional Nash games and their representation as variational inequalities. Chapter 6 presents the foundations of open loop dynamic Nash games and their representation as differential variational inequalities. Chapters 7, 8, 9 and 10 are devoted, respectively, to the following applications: economic growth theory; production planning and supply chains; dynamic user equilibrium; and pricing and revenue management.

I regret that the press of time has not permitted me to cover differential Stackelberg games or to include chapters on stochastic differential games. It is my hope that these and other incomplete aspects of the book may someday be overcome in a revised edition.

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