

Preface

This book aims to present new developments in control and decision-making theory in the field of human–robot interaction (HRI). Despite advances in robotics, sensing, and autonomy, human participation is still an essential component in various operations, especially under uncertain and complex environments. In particular, human–robot collaboration (HRC) systems integrate the strengths of human in terms of high-level decision-making, flexibility, dexterity, vision processing, etc., with robot’s capabilities of performing repetitive tasks in dangerous situations in order to realize the full potential of autonomous systems. Therefore, a considerable amount of effort has been made in this area, which however still lacks qualitative analysis, performance prediction, and guarantees. This offers little insight into the effective control and decision-making for the collaboration operations, especially in real time.

To fill the gap, the chapters in this book discuss in detail the development of new control and decision-making algorithms for HRC systems for guaranteed joint human–robot system performance. Chapter 1 provides an overview of the extant works in HRI and detailed introduction of main contributions of each chapter. Chapters 2–9 present methods for one human–robot pair collaboration and Chaps. 10–16 develop the control and coordination algorithms for humans to collaborate with multiple robots and swarms. Both physical (e.g., force, vision) and psychological human factors (e.g., trust and regret) are embedded into control and decision-making approaches such as nonlinear control, shared control, switching control, optimal control, and sequential detection. The considered applications include transportation, healthcare, manufacturing, and defense. Robot experiments and simulations with human-in-the-loop are conducted to demonstrate the effectiveness of the proposed algorithms.

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