Preface

The love of learning, the sequestered nooks,
And all the sweet serenity of books.
– Henry Wadsworth Longfellow, 'Morituri Salutamus,' 1875

Intense global competition in manufacturing has compelled manufacturers to incorporate automation and repetitive processing for improving productivity. As manufacturers strive to reduce cost and improve productivity, the benefits offered by computer-controlled material handling systems – efficiency and speed of processing, reduced labor costs, a largely contaminant-free environment, to name a few – are compelling reasons for their use. In their typical use, such systems are responsible for all inter-machine handling of work-in-process as raw materials progress through the multiple processing stages required to produce a finished part.

Many modern manufacturing systems use robot-served manufacturing cells, or *robotic cells* – a particular type of computer-controlled manufacturing system in cellular manufacturing. The exact time of the first use of such systems is difficult to pinpoint; however, several industrial implementations were in use in the 1970s. Most of these were classical machining applications such as automated tool loading and unloading for metal-cutting, grinding, turning, etc., and automated classification of parts before palletizing. Over the years, the scope has broadened to a wide variety of industries including the manufacture of semiconductors, textiles, pharmaceutical compounds, magnetic resonance imaging systems, glass products, cosmetics, fiber-optics, and building products.

As they become prevalent, using robotic cells efficiently becomes a competitive necessity. In this regard, research efforts have focused on three major issues: cell design, sequencing of robot moves, and optimal scheduling of the parts to be produced. The latter two issues are the subject of most of our discussion in this book. In particular, our emphasis is on cyclic production in which a sequence of robot actions is repeated until the production target is met.

This book is devoted to consolidating the available structural results about cyclic production in the various models used to represent real-world cells. As cells become larger and more complex, the need for increasingly versatile models and easy-to-implement algorithms to optimize cell operations has increased. We have made an attempt to bring together the results developed over the past 25 years. The material is organized into 10 chapters. We start by taking a look at industrial applications and formulating a classification scheme for robotic cell problems. After presenting some fundamental results about cyclic production, we proceed to analyze cells with dual-gripper robots, parallel machines, multiple-part-type production, and multiple robots. Finally, we discuss some important open problems in the area.

We envision this book as a reference resource for practitioners, researchers, and students. The book can also be used in a graduate course or a research seminar on robotic cells.

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