Preface

Imagine a flock of birds migrating south before winter. The flock is composed of identical birds, but no one bird is the leader, nor can any one bird always see all the other birds. The birds obviously have a common objective—to fly from one general area to another specified location. At any one time there is a small number of birds at the front, but this group changes as the birds fatigue. The birds cooperate in order to fulfill the overall function of group migration. We can view this flock of birds as a *distributed system*, the adjective "distributed" not necessarily meaning geographically distributed, but rather distributed in function or authority. Besides a flock of birds you could imagine a school of fish or a colony of ants. Now think of such a system except where each bird (or fish or ant) is replaced by a mobile robot: a wheeled rover on the ground or a quadrocopter in the air. Then you have a distributed system of robots, and that is the subject of this book.

In the late twentieth century the research subject of distributed robotics burst on the scene, grew very quickly, and has become a core subject within control theory and engineering. Computer scientists, control theorists, roboticists, and other scientists and engineers have contributed to the subject. There is now a significant body of theory and also of experimental prototypes.

This book takes as its launchpad the 2014 IEEE Bode Lecture entitled "The Rendezvous Problem." The book covers the two most basic problems of distributed robotics, the flocking problem and the rendezvous problem, for wheeled robots and quadrocopters. Quadrocopters was not touched in the Bode Lecture and consequently is a feature of this book. The book is aimed at graduate students and others who wish to get into this subject. We view formation flying of quadrocopters as an especially fertile field for new Ph.D. theses.

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