Chapter 8

Epilogue

Solving a problem in optimal control or estimation is not easy. Pieces of the puzzle are found scattered throughout many different disciplines. At the very least, one needs an "optimization" method and a "differential equation" method. A rudimentary understanding of modern control theory is helpful, to say nothing of expertise in the domain of application. In my experience, the most challenging practical problems originate with experts in a particular domain. An aerodynamicist feels comfortable discussing "lift" and "drag" but is less familiar with index-two DAEs. Chemical engineers can readily describe a batch feed process but become uneasy when discussing the KKT conditions. Often this domain expertise has been painstakingly developed over many years and involves complex computer simulations and/or expensive experimental studies.

Thus, when faced with an optimal control or estimation problem it is tempting for the domain expert (i.e., the structural engineer, biochemist, etc.) to simply "paste" together packages for optimization and numerical integration. While naive approaches such as this may be moderately successful, the goal of this book is to suggest that there is a better way! The methods used to solve the differential equations and optimize the functions are intimately related. Furthermore design and development of the "simulation" or experimental trial should be done with the intent to optimize. Optimization is not an afterthought. Indeed, perhaps the most important issue needed to successfully solve a problem is the proper formulation. And so I close with the following:

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If there is a flaw in the problem formulation, the optimization algorithm will find it.[11]

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[11] The proof is left to the student.