Preface

A foolish consistency is the hobgoblin of little minds,...

Ralph Waldo Emerson, *Self Reliance*

This book is based largely on courses that I have taught at the Feinberg Graduate School of the Weizmann Institute of Science over the past 35 years to graduate students with widely varying levels of mathematical sophistication and interests. The objective of a number of these courses was to present a user-friendly introduction to linear algebra and its many applications. Over the years I wrote and rewrote (and then, more often than not, rewrote some more) assorted sets of notes and learned many interesting things en route. This book is the current end product of that process. The emphasis is on developing a comfortable familiarity with the material. Many lemmas and theorems are made plausible by discussing an example that is chosen to make the underlying ideas transparent in lieu of a formal proof; i.e., I have tried to present the material in the way that most of the mathematicians that I know work rather than in the way they write. The coverage is not intended to be exhaustive (or exhausting), but rather to indicate the rich terrain that is part of the domain of linear algebra and to present a decent sample of some of the tools of the trade of a working analyst that I have absorbed and have found useful and interesting in more than 40 years in the business. To put it another way, I wish someone had taught me this material when I was a graduate student. In those days, in the arrogance of youth, I thought that linear algebra was for boys and girls and that real men and women worked in functional analysis. However, this is but one of many opinions that did not stand the test of time.

In my opinion, the material in this book can (and has been) used on many levels. A core course in classical linear algebra topics can be based on the first six chapters, plus selected topics from Chapters 7–9 and 13. The latter treats difference equations, differential equations and systems thereof. Chapters 14–16 cover applications to vector calculus, including a proof of the implicit function based on the contractive fixed point theorem, and extremal problems with constraints. Subsequent chapters deal with matrix valued holomorphic functions, matrix equations, realization theory, eigenvalue location problems, zero location problems, convexity, and matrices with nonnegative entries. I have taken the liberty of straying into areas that I consider significant, even though they are not usually viewed as part of the package associated with linear algebra. Thus, for example, I have added short sections on complex function theory, Fourier analysis, Lyapunov functions for dynamical systems, boundary value problems and more. A number of the applications are taken from control theory.

I have adapted material from many sources. But the one which was most significant for at least the starting point of a number of topics covered in this work is the wonderful book [**45**] by Lancaster and Tismenetsky.

A number of students read and commented on substantial sections of assorted drafts: Boris Ettinger, Ariel Ginis, Royi Lachmi, Mark Kozdoba, Evgeny Muzikantov, Simcha Rimler, Jonathan Ronen, Idith Segev and Amit Weinberg. I thank them all, and extend my appreciation to two senior readers: Aad Dijksma and Andrei Iacob for their helpful insightful remarks. A special note of thanks goes to Deborah Smith, my copy editor at AMS, for her sharp eye and expertise in the world of commas and semicolons.

On the production side, I thank Jason Friedman for typing an early version, and our secretaries Diana Mandelik, Ruby Musrie, Linda Alman, Terry Debesh, all of whom typed selections and to Diana again for preparing all the figures and clarifying numerous mysterious intricacies of Latex. I also thank Barbara Beeton of AMS for helpful advice on AMS Latex.

One of the difficulties in preparing a manuscript for a book is knowing when to let go. It is always possible to write it better.[1] Fortunately AMS maintains a web page: http://www.ams.org/bookpages/gsm-78, for sins of omission and commission (or just plain afterthoughts).

TAM, ACH TEREM NISHLAM,...
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Rehovot, Israel

[1]Israel Gohberg tells of a conversation with Lev Sakhnovich that took place in Odessa many years ago: Lev: Israel, how is your book with Mark Gregorovic (Krein) progressing? Israel: It's about 85% done. Lev: That's great! Why so sad? Israel: If you would have asked me yesterday, I would have said 95%.