Linear Algebra Labs with MATLAB (3rd Edition)

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This work has two primary parts. One consists of the 13 LABS and three Projects in this manual. The other is a set of instructional M-files that harness the power of the software package MATLAB tm to render it appropriate for an educational setting. The LABS and Projects are meant to supplement a standard sophomore level course in linear algebra. They follow the general outline for such a course, introducing instructional routines and appropriate MATLAB commands to solve problems related to each concept. Our primary goal is to use the laboratory experiences to aid in understanding the basic ideas of linear algebra. As such we use instructional M-files that provide a tool kit for working with linear algebra without the need for programming in the MATLAB command set. Although no programming background is assumed, those students with computing skills can further enhance their skills within MATLAB. We have found that students initially rely on the tool kit, but many quickly begin to use MATLAB commands directly, even though we provide little formal instruction in this area. We recommend an instructional approach that integrates the language and terminology of computing within the lecture format. In addition, when possible and appropriate, computer demonstrations and experiments should be used in lectures. Three of the LABS are different from the others. LAB 5 examines sets with addition and scalar multiplication and investigates the defining properties of a vector space in a pedagogical way. LAB 8 presents the defining properties of the determinant in such a way that a considerable amount of class time can be saved on this topic. Also, LAB 11 presents an independent supplement to the standard classroom coverage of linear transformations by examining the geometry of plane linear transformations. New Section 11.2 introduces homogeneous coordinates to incorporate translations. The LABS are not self contained. Except for LABS 8 and 11, they assume that the material has already been presented in the classroom. Sometimes, however, it is expedient to discuss a topic using a fresh, computational approach. New material has been added to this third addition, both in the LABS and in the accompanying instructional M-files. The modifications to the LABS provide a number of alternate approaches to topics some of which use more graphically oriented M-files to provide visualization of concepts. Many of the instructional M-files have been enhanced to take advantage of the graphical user interface GUI available in MATLAB . In addition we have included instructional files that use the Symbolic Math Toolbox. These sections can be omitted without loss of continuity if this toolbox is not available. A detailed list of new features is on page viii and a short description of all the instructional files is on page x. A full description of the instructional files is available by printing alldesc.txt that accompanies the tool kit of instructional files. We extend our sincere gratitude to the National Science Foundation ILI #DMS-9051282 for providing the funds for implementing a mathematics laboratory at Temple University. This facility provided the educational arena necessary to develop the laboratory materials and extend our instructional M-files for MATLAB from 1990 to 1993. We thank the many students who were patient with and receptive to using the laboratory to aid in the development and understanding of the concepts of linear algebra. A special thanks to our colleague Dr. Nicholas Macri for his valuable assistance in designing and preparing this manual. David R. Hill David E. Zitarelh May, 2003

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