Anywhere-Anytime Signals and Systems Laboratory

From MATLAB to Smartphones

Second Edition

Synthesis Lectures on Signal Processing

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Nasser Kehtarnavaz, Fatemeh Saki, and Adrian Duran
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Second Edition

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SYNTHESIS LECTURES ON SIGNAL PROCESSING #15

ABSTRACT

A typical undergraduate electrical engineering curriculum incorporates a signals and systems course. The widely used approach for the laboratory component of such courses involves the utilization of MATLAB to implement signals and systems concepts. This book presents a newly developed laboratory paradigm where MATLAB codes are made to run on smartphones, which most students already possess. This smartphone-based approach enables an anywhere-anytime platform for students to conduct signals and systems experiments. This book covers the laboratory experiments that are normally covered in signals and systems courses and discusses how to run MATLAB codes for these experiments on both Android and iOS smartphones, thus enabling a truly mobile laboratory environment for students to learn the implementation aspects of signals and systems concepts.

A zipped file of the codes discussed in the book can be acquired via the website `http://sites.fastspring.com/bookcodes/product/SignalsSystemsBookcodesSecondEdition`.

KEYWORDS

smartphone-based signals and systems laboratory; anywhere-anytime platform for signals and system courses; from MATLAB to smartphones

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Preface

A typical undergraduate electrical engineering curriculum incorporates a signals and systems course where students normally first encounter signal processing concepts of convolution, Fourier series, Fourier transform, and discrete Fourier transform. For the laboratory component of such courses, the conventional approach has involved a laboratory environment consisting of computers running MATLAB codes. There exist a number of lab textbooks or manuals for the laboratory component of signals and systems courses based on MATLAB, e.g., *An Interactive Approach to Signals and Systems Laboratory* by Kehtarnavaz, Loizou, and Rahman; *Signals and Systems Laboratory with MATLAB* by Palamides and Veloni; *Signals and Systems: A Primer with MATLAB* by Sadiku and Ali; and *Signals and Systems* by Mitra.

The motivation for writing this lab textbook or manual has been to provide an alternative laboratory approach to the above conventional laboratory approach by using smartphones as a truly mobile anywhere-anytime platform for students to run signals and systems codes written in MATLAB on smartphones. This approach eases the requirement of using a dedicated laboratory room for signals and systems courses and allows students to use their own laptop and smartphones as the laboratory platform to learn the implementation aspects of signals and systems concepts. It is worth stating that this book is only meant as an accompanying lab book to signals and systems textbooks and is not meant to be used as a substitute for these textbooks.

The challenge in developing this alternative approach has been to limit the programming language required from students to MATLAB and not requiring them to know any other programming language. MATLAB is extensively used in engineering departments and students are often expected to use it for various courses they take during their undergraduate studies.

The above challenge is met here by using the smartphone software tools that are publicly available. The software development environments of smartphones (both Android and iOS) are free of charge and students can download and place them on their own laptops to be able to run signals and systems algorithms written in MATLAB on their own smartphones. In this lecture series book, we have developed the software shells that allow students to take MATLAB codes written on a laptop and run them on their own smartphones as apps. In the first edition of the book, the implementation was done on Android smartphones. In this second edition, in addition to Android smartphones, the implementation is done on iOS smartphones.

The book chapters correspond to the following labs for a semester-long lab course considering that a typical signals and systems laboratory component includes labs 4–7: (1) introduction to MATLAB programming; (2) smartphone development tools (both Andorid and iOS); (3) use of MATLAB Coder to generate C codes from MATLAB and how to run C codes

on smartphones as apps; (4) linear time-invariant systems and convolution; (5) Fourier series; (6) continuous-time Fourier transform; and (7) digital signals and discrete Fourier transform.

Note that a zipped file of all the codes discussed in the book can be acquired from the website http://sites.fastspring.com/bookcodes/product/SignalsSystemsBookcodesSecondEdition.

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