

Chapter 7

Interactive Applets in Calculus and Engineering Courses

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ABSTRACT

This chapter reports on the use of specialized computer applets (“Mathlets”) in two different contexts: on-line instruction in calculus through MIT OpenCourseWare and on-campus laboratory exercises on stability of difference schemes in class. Specific applets are described. Three use cases with varying levels of sophistication (elementary, intermediate, and advanced) are outlined.

INTRODUCTION

In the fall of 2000, a group in the MIT Mathematics Department began work on a suite of computer applets (“MIT Mathlets”) designed to support basic MIT mathematics education. For a report on this work and a review of relevant literature see Miller and Upton (2008). The current state of this collection, along with supplementary material, can be found at <http://math.mit.edu/mathlets/>. The intent of this chapter is to discuss the recent design and application of two new families of MIT Mathlets serving very different audiences:

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- Calculus tools designed for self-learners and delivered over the Internet through MIT OpenCourseWare.
- Tools designed for use in an aerospace engineering classroom workshop to aid in understanding the stability of certain difference schemes.

We will begin by describing the pedagogical factors guiding the creation of this family of applets, the history of their early development, and the background for the recent additions. The next section is devoted to the design and usage of calculus applets for self-learners, and the section that follows to similar treatment of the Eigenvalue Stability applet built for use in an Aerospace Engineering class. We wrap up each section with some lessons learned and a sketch of future work in this direction.

BACKGROUND

Development of the MIT Mathlets began in the Fall of 2000 under a grant from the MIT d'Arbelloff Fund for Excellence in Education. Initially they focused on material for the large course on Ordinary Differential Equations. In the spring of 2003 they were first introduced in that course as lecture demo material and, more powerfully, as a framework for homework assignments. This initial phase of development is reported on by Miller and Upton (2008, available also online), where a detailed study of the pedagogical impact of the applets can be found. As described in that paper, the initial MIT Mathlets began as modifications of applets created for an earlier project, Interactive Differential Equations (2008), authored by Beverly West, Steven Strogatz, Jean Marie McGill, and John Cantwell. The applets for IDE (short of Interactive Differential Equations) were designed and programmed by Hu Hohn, Director of the Computer Arts Center at Massachusetts College of Art, and Hohn continued the development of this initial group and many subsequent applets for the MIT project.

Several well-defined overarching design elements, described in Miller and Upton (2008) shaped the creation of these tools and continue to shape the new ones. They may be summarized as follows. Each applet

- Responds in real time to slider or cursor movements determining system parameters.
- Is narrowly focused, providing maximal insight into important concepts using carefully selected examples.

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