

iSeismograph: Macintosh-Based Accelerometer and Camera Driver

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Last Modified: 2008-10-15 Version: 1.1

I Abstract

All Macintosh laptop computers today are equipped with a 3-axis accelerometer. This built-in accelerometer helps to freeze the hard drive and save its contents if the accelerometer/processor detect a potential impending free-fall of the laptop. Through the Macintosh software framework, the accelerometer and the built-in camera can be accessed for display and recording of the dynamic accelerometer response and the camera image. Employing the NEESit software RDV, response of the accelerometer may be displayed along with the synchronized video images. The response in the form and images and accelerations may be recorded for future display and review. The data can be later archived for use in various other applications.

2 Introduction

The earthquake community often employs an external accelerometer connected to a PC data acquisition board to record and display dynamic response. Applications span the broad scope of k-12, undergraduate, and graduate education and research. Adding the capability of recording motion through a video camera is a direction that is currently receiving some attention as well.

All new Macintosh laptops currently include a built-in 3-dimensional (3D) accelerometer and a video camera. Utilizing these capabilities would allow the laptop to be employed as a recording station, in a most convenient and straightforward fashion. Recognizing the presence of the built-in accelerometer researchers from the NSF IRIS project have developed a valuable portable demo (<http://www.suitable.com/tools/seismac.html>) for deployment and use on any recent Macintosh laptop (SeisMac, Figure 1).

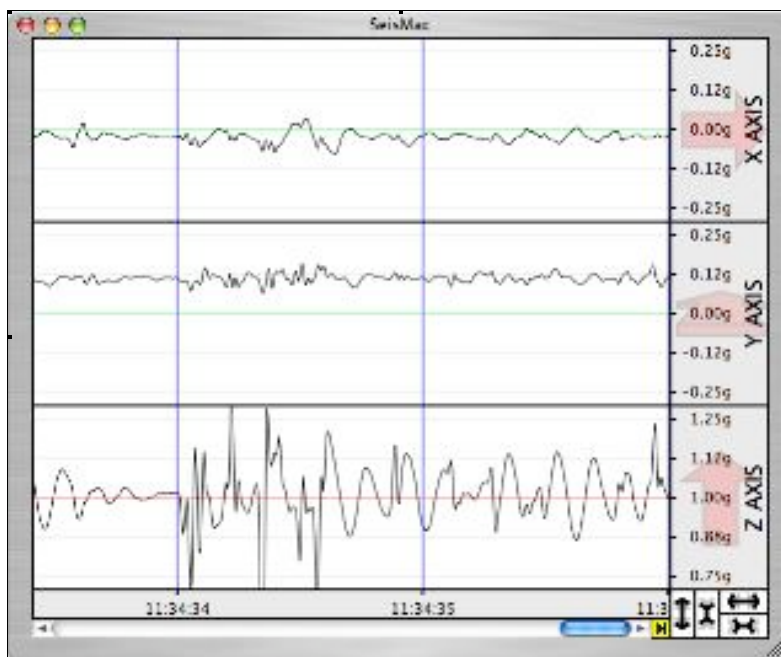


Figure 1: Screenshot from the IRIS SeisMac Display

SeisMac is an NSF-funded application, and is free to download. However, the source code is currently unavailable, and no capability is available for saving numeric data (for further analysis). As mentioned

earlier, SeisMac is based on the fact that all recent Apple laptops have a built-in accelerometer <http://docs.info.apple.com/article.html?artnum=300781> known as the Sudden Motion Sensor, or SMS. Apple uses this accelerometer to detect a drop, so that the hard drive can park and prevent data loss. However, Apple does expose the SMS to programmers and SeisMac is one demonstration of that (as a side note, several newer IBM ThinkPads have the same chip, but is not available to programmers.)

Based on our intended application, a way was needed to read the SMS from Java, so that a simple program can be written that read the chip and sent the readings to the NEESit DataTurbine environment. Through the DataTurbine, this data would then become available to the full suite of telepresence tools developed by NEESit. To achieve this goal, resort was made to <http://members.optusnet.com.au/lbramsay/programs/unimotion.html> by Lincoln Ramsay, which puts a simple API in C on the SMS. The SMS Java Library by Daniel Shiffman's further simplified the process <http://www.shiffman.net/p5/sms>. On this basis, what remained to achieve a working code was to write the invocation and the DataTurbine code.

3 About the Code

Currently, the core of the software is contained in a single Java file, `sms_rbnb.java`. The project in Subversion also contains the SMS libraries required to build and run it, as well as an Ant build.xml for compiling and running the code. There is also an Xcode project for working on the code. The structure of the code is fairly straightforward:

1. Initialize RBNB connection
 - i) Setup append connection, with cache and archive
 - ii) Register channels and metadata for same (units, MIME type)
2. Initialize SMS library
3. Loop until interrupted
 - i) Read SMS values
 - ii) Create timestamp from system clock
 - iii) Convert data from counts into acceleration
 - iv) Push data into DataTurbine
 - v) Sleep 50 milliseconds (20Hz update rate)
4. Detach from the DataTurbine, so that data is saved after the test is complete

4 Limitations

This software as it has been currently shipped is for educational and demonstration purposes only. Proper calibration of the accelerometer, and a few other issues need to be resolved in order to make iSeismograph a scientific software instrument.

5 Current Status

iSeismograph installs easily on any Macbook or Macbook Pro; a single click on the installation jar file will immediately bring up an install wizard to guide you through the process. iSeismograph is also fully self-contained, and requires no external Data Turbine or RDV installation; the software can be removed by simply dragging the Application/iSeismograph folder in the trash. The disk footprint of an installation sans recorded data is eleven megabytes.

Thus, any Macbook or Macbook Pro can become an on-demand iSeismograph, creating a valuable educational and Data Turbine demonstration tool. iSeismograph is currently available only for Apple Macintosh laptop computers, as they are the only platform at present which ships standard with embedded accelerometer hardware. Interested users can download iSeismograph at the following location: <http://it.nees.org/software/iSeismograph>

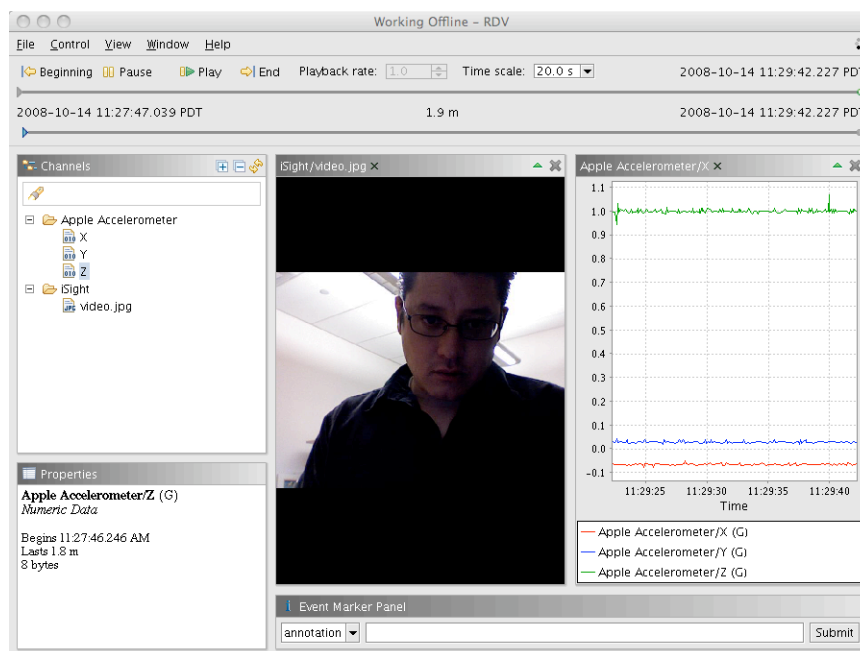


Figure 2: Screenshot of RDV Displaying Live Data

Access to the Source Code

The current version of the source code is available at NEESforge (<http://neesforge.nees.org/>).