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Data dissemination and research activities of the California Strong Motion Instrumentation Program

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ABSTRACT: The California Strong Motion Instrumentation Program is instrumenting ground response sites, buildings, and other structures throughout California to measure their response during strong earthquake shaking. Large earthquakes in 1992 significantly extend the magnitude range of the data set recorded by the network. Earthquake engineering research supported by the Program is focused on interpreting strong-motion data with the ultimate goal of improving seismic design codes and construction practices.

INTRODUCTION

The California Strong Motion Instrumentation Program (CSMIP) is part of the State of California Department of Conservation's Division of Mines and Geology. It was started after the 1971 San Fernando earthquake, during which unexpected strong shaking and damage occurred. Data recorded by the network is disseminated by various means in California and throughout the world, and interpretational studies are supported to maximize learning from the recovered data. The CSMIP program is funded by a fee on building permits in California, and as a result the program is focussed on addressing the State's needs in reducing earthquake hazard.

The CSMIP network currently has 540 stations installed throughout California, including:

a) 378 ground response sites, in which a triaxial recorder is located in an instrument enclosure or small structure;
b) 130 extensively-instrumented buildings, in which accelerometers are distributed throughout a building and cabled to a central recorder, with typically 12 to 16 accelerometers per building;
c) 20 extensively-instrumented dams, earthen and concrete, with up to 15 distributed accelerometers; and
d) 12 extensively-instrumented bridges and other lifeline facilities, with up to 36 accelerometers.

The network is comprised of both analog and digital accelerographs, but analog instruments predominate. A highly variable but usually large number of records are obtained by the network each year. The number of records recovered during 1992 will be one of the largest ever, with over 1000 records recovered. Significant analog records, important because of their amplitude or because they are part of an earthquake or station data set, are digitized and processed to obtain spectra and corrected velocity and displacement time series. Approximately 500 records from more than 20 earthquakes have been digitized and are available to users.

DATA DISSEMINATION

CSMIP data is disseminated in several ways: 1) by floppy disk; 2) by magnetic tape; 3) by graphical plots in reports; 4) by parametric tables in reports and papers; and 5) by CD-ROM in cooperation with the U.S. Geological Survey. Many user requests for digitized data are shifting to floppy disk. For example, a few years ago 80% of requests were for magnetic tape. Now 70% of the requests call for floppy disks. Note that while this shift provides more convenience for the user, it results in more logistical effort for a dissemination center. Approximately 15 floppy disks may be required to hold the data that can be included on a single ½" 2400-ft computer tape.

Data disseminated during the last year includes 1,100 floppy disks (5¼" and 3½" high density), 70 computer tapes, and 1,500 copies of reports. A total of over 2,000 megabytes of data was shipped last year. Data and reports are distributed at approximate distribution costs in California. A higher rate is used for non-California requests. The data user base continues to broaden. Novice, first-time users continue to request data, and are learning about strong-motion data as they begin their studies.

To ease the logistical effort compression of data for distribution was introduced this year. The compression is self-expanding and completely reversible. A compression factor near 4 is typical (i.e., the compressed data takes only about 1/4 the storage volume of the uncompressed data). To use the data, the user loads the compressed file onto the hard disk and it expands with a simple command, after which the data can be used normally.

Types of Data Requests

A data dissemination center must organize staff and procedures to handle incoming data requests effectively. Data requests can be divided into two general classes. Most requests are focused. Examples include a request for all records from one earthquake (or one year, or one region). Another typical focused request might be for specific records (from a particular station for a particular event, for example). In general, focussed requests can be handled quickly and efficiently.

A second group of request is unfocused. For example, a user may request all important records from appropriate events from stations with geologic conditions corresponding to some specified site. Filling these requests can become a small research project. The requests often come from geotechnical consulting firms with limited background in the field. Unfocused requests can be difficult and expensive to respond to thoroughly. A dissemination center must decide whether it can devote the staff support and resources necessary to perform this service.

Even among focused requests, user requests for ground response and building data tend to be different in that requests for building data are usually quite specific. For example, a ground response investigator may request all records from a certain earthquake, while a building response investigator may only want the record for a single building for use in a modeling or analysis study. For that reason data dissemination by segmented sets is most effective, rather than distributing a set of data containing all the records in a certain earthquake.

RESEARCH ACTIVITIES

Besides instrumenting stations and disseminating data, CSMIP maintains a directed research and data interpretation project. Research efforts include studies on the response of structures during earthquakes and on strong-motion data processing. Other research studies include measurement and study of weak and strong motion to investigate evidence of nonlinearity. Some data interpretation studies funded by CSMIP are conducted in universities and by earthquake engineers in the private sector. An annual seminar is held at which research results are presented. The seminars are designed to transfer research findings on strong-motion data to practicing seismic design professionals and earth scientists. Two examples of recently completed projects include an analysis of the seismic response of an elevated rapid-transit bridge structure and a study of the soil-structure interaction of a mid-rise building. Reports produced as part of the data interpretation projects are available for dissemination just as network data itself.

REQUESTS FOR DATA

Requests for CSMIP data and reports may be addressed to:

Data Reduction Manager
California Strong Motion Instrumentation Program
Division of Mines and Geology
California Department of Conservation
801 K Street, MS 13-35
Sacramento, California, USA 95814-3531.