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VI.5 The Global Digital Seismograph Network software package

Introduction

The Global Digital Seismograph Network (GDSN) is now in full operation
providing seismic waveform data from SRO, ASRO and DWWSSN stations.
It is described in a number of articles including Peterson et al (1976)
and Zibres and Buland (1981), and it is the subject of a new Newsletter
published by the USGS.

A comprehensive software package is written and dispatched to various
seismological agencies to read data tapes generated at the GDSN stations
(Zibres and Buland, 1981). The aim of this report is to suggest new ex-
tensions to the package such that it can incorporate seismologists'
requests directly and reduce the volume of unnecessary data tapes
that should be dispatched to individual users.

The Zibres and Buland package, called the Network-Day Tape Software
(NDTS), is thus modified into a new one called GDSN software package
hereafter. The GDSN package is prepared to operate in much the same
way as NDTS but to include many additional options not considered in
the latter.

The GDSN software package is described in the next section where a
flowchart diagram (Fig. VI.5.1) is used to demonstrate how it is linked
to the NDTS. A useful option in the GDSN is its Help Manager, a sub-
routine which can be accessed by users and helps them to understand
and operate the package. The Help Manager is given in Appendix VI.5.1.
A practical GDSN users' guide mainly for the NORSAR installation is
given in Appendix VI.5.2.

The GDSN software package

The aim of both NDTS and GDSN software packages is mainly to read the
seismic waveform data from data tapes, reformat and copy to disk
files for further processing. Therefore, most tasks require two steps:
In the first step the waveform data are transformed from data tapes to

disk files, and in the second step the disk files are used to process the
retrieved data. Although both software packages are essentially written
to do the first step, they provide options for the second step too.

The NDTS provides all necessary subroutines for using the GDSN data
tapes, a complete collection of which is available only in a few places
such as the USGS in the US and the NORSAR data processing center in
Norway. The potential users normally require a large number of data
tapes which must be sent to them, a slow and expensive process. An
alternative is to provide the users with all waveform data they want
and according to their specifications ideally on one or two tapes.
The GDSN software package provides all the additional subroutines
to do this service. It is therefore most useful in the main data
centers with complete data tape libraries.

The GDSN package is based on the idea that by the time the data tapes
are available at the main data centers, the hypocenter information
is also available for the same data. To demonstrate the operation
procedure of the GDSN software package, let us now consider a typical
user request.

Long period P waveform data for all events that occurred within a
certain time period (say 1975 to 1982), within a certain magnitude
range (say 5.5 to 7.0) from all GDSN stations within a certain
distance range (say 20 to 90°) are requested.

At a main data center first the USGS or ISC hypocenter information
files are searched for all events that satisfy the above request, and
an EVENT DATA file is assembled. Then the GDSN software package is
asked to take this file, retrieve the waveform data and file on disk
(or tape). The end result contains both hypocenter information and
waveform data, can be put on one or two tapes for say 100 events at 30
stations each and dispatched to the users.

Steps in the GDSN software package for doing this or similar tasks
are shown in the flowchart diagram in Fig. VI.5.1 and are described
below

Step 0 - Initialize the GDSN software package by giving an event number
from the EVENT DATA file to start with, the number of runs
(i.e., number of events to do) and an initialization token.

Step 1 - Enter a program called MAKIN, and make an input file for the
NDTS according to specified selection options decided by the
user's request (MAKIN uses JB travel time tables to find
approximate P wave arrival time for each event-station set
up). If waveform data are not requested, this step will be
bypassed.

Step 2 - Enter a program called GSET, decide a route in the NDTS cor-
responding to the given request, name disk output files and
request the GDSN data tape for the current event to be mounted
on the system. At this stage it is possible to enter the Help
Manager and obtain information on the features of the GDSN
software package.

Step 3 - Enter a program called GTAPE, and enter the correct subroutine
in the NDTS according to the route decided in step 2.

Step 4 - If waveform data are retrieved, enter a program called CATLG
and catalog the event number.

Step 5 - Enter a program called GDSNDP and plot the waveform data
for all the stations for this event.

At this stage, one event is completed and the package loops for more
events (if requested) and repeats steps 1-5. From this stage until the
end of the run the package uses selection options and parameters decided

in steps 1 and 2, and halts only to request for a new GDSN data tape
to be mounted on the system.

At the end of the run all waveform data files for all of the event-
station sets are completed and may be transferred to tapes and dis-
patched to the users.

The disk I/O routes are managed in an independent step in the GDSN
package. A FORTRAN program reads an event from the EVENT DATA file
and assembles files specifications from the origin time of the event.
This naming scheme is applied only to those files that are to be used
in every task, and all other files normally required by the NDTS are
routed to a dummy file which is deleted at the end of the run. This
is important in view of the fact that NDTS requires seven waveform
data files and one identification file for each event, while in most
practical tasks only a fraction of these files are actually used
(only 2 files are needed to retrieve short period component waveform
data).

It has to be emphasized that all original features of NDTS are preserved
in the GDSN, and besides some installation-dependent modifications,
the only other modification is to make the four main commands of
NDTS (see Zibres and Buland, 1981) operate like subroutines.

An additional facility available in the GDSN package is a disk-oriented
routine to analyze events after the waveform data is copied to disk
files. It is a general purpose FORTRAN program that can be adapted
to individual users' problems with little effort. It also operates
through the user's EVENT DATA file and uses the same file specifica-
tion manager as the main package.

In summary, the GDSN software package covers all the features of
the NDTS but also includes the following new features:

a)   It uses the entire NDTS in its original form except for the neces-
        sary modification required by the local installation. Thus, it can
        easily accommodate new and updated versions of the NDTS.

b)   Since the exact waveform windows are calculated, considerable saving
        is achieved in the disk or tape space used by the waveform data files.

c)   The hypocenter information is included in the identification file
        which is created for every event. Therefore, for the next stages of
        processing both waveform data and hypocentral data are available
        for every event.

d)   Using an installation-independent disk I/O manager, the user need
        not do any bookkeeping on files, etc. An EVENT DATA file is all that
        is needed. To process each event after waveform data are copied
        to disk files, the user enters only the event number from his EVENT
        DATA file and starts processing.

e)   The GDSN package is transportable and can be easily adapted to most
        computer installations.

It is hoped that these new and practical modifications encourage more use
of the GDSN data, and that the suggested modifications be installed at the
main data centers that distribute the GDSN data tapes.

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References

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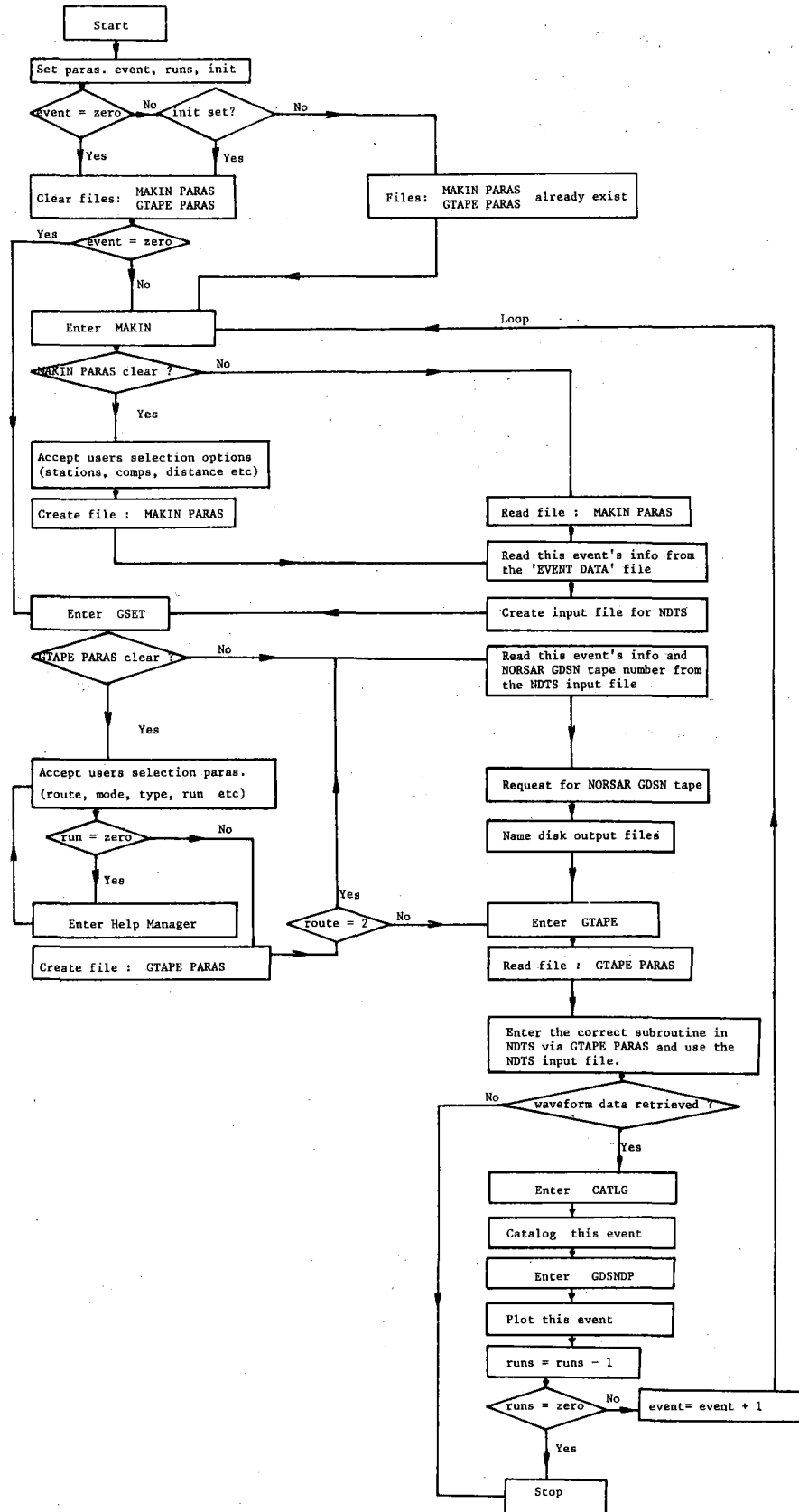   Open-File Report 81-666.

Start

Set paras. event, runs, init

event = zero No init set? No

Yes Yes

Clear files: MAKIN PARAS GTAPE PARAS

Files: MAKIN PARAS GTAPE PARAS already exist

Yes event = zero

No

Enter MAKIN

Loop

MAKIN PARAS clear ? No

Yes

Accept users selection options (stations, comps, distance etc)

Create file : MAKIN PARAS

Read file : MAKIN PARAS

Read this event's info from the 'EVENT DATA' file

Enter GSET

Create input file for NDTS

GTAPE PARAS clear ? No

Read this event's info and NORSAR GDSN tape number from the NDTS input file

Yes

Accept users selection paras. (route, mode, type, run etc)

Request for NORSAR GDSN tape

run = zero No

Name disk output files

Yes

Enter Help Manager

Yes route = 2 No Enter GTAPE

Create file : GTAPE PARAS

Read file : GTAPE PARAS

Enter the correct subroutine in NDTS via GTAPE PARAS and use the NDTS input file.

No waveform data retrieved ?

Yes

Enter CATLG

Catalog this event

Enter GDSNDP

Plot this event

runs = runs - 1

runs = zero No event= event + 1

Yes

Stop

Fig. VI.5.1

Appendix VI.5.1 - The GDSN Help Manager

At the initial step of the GDSN software package, the user receives help to tailor an initialization set up for his task. Furthermore, the user may also enter the GDSN Help Manager to get additional information on all aspects of the GDSN. Once entered the Help Manager, part or all of the following information will be displayed at the user's terminal:

```
I CAN HELP YOU ON THE FOLLOWING ITEMS:
GDSN               What is GDSN ?
ROUTe              Want data log summaries or waveform data ?
MODE               Is your data tape recorded after 1.1.1980 ?
TYPE               Do you have Network-Day or Single tape ?
RUN                How do you run the package ?
TAPEs              What is a GDSN tape ?
FILEs              How do you name your Disk output files ?
INTEractive run    If you are BEGINNER !
PRODuction run     If you want the package to do it for you.
EXECs              How is the package executed ?
ALL                If you want all of the above.
QUIT               If you want to get out of HELP.

SELECT ONE:
```

If you select ALL, all information in the Help Manager shown below will be displayed at your terminal.

```
   GDSN                                          HELP MANAGER

   Global Digital Seismograph Network (GDSN) Help Manager

   A comprehensive software package is developed by USGS to
read the data tapes produced at SRO, ASRO and DWWSSN stations.
This packages reads both Signle station and Network-Day tapes
and is called Network-Day Tape Software (NTDS).
(see Zibres and Buland, USGS open file report 81-666.)
   The NORSAR adaptation of NDTS is called GDSN software package
and this Help Manager provides a quick guide for using it.
It explains the package switches ROUTE, MODE, TYPE and RUN
as well as TAPE and FILE formats and suggested procedures
for running the package.
   Additional documentation on GDSN package is given in the file
GDSN MEMO.

P.S. You entered GTAPE at your terminal to run the package!
```

ROUTe   HELP MANAGER

   The ROUTE switch directs the GDSN package into two main
routes. ROUTE can be either 1 or 2.
If ROUTE is 1, the package reads and files out the data log
summaries from a GDSN tape without actually retrieving waveform
data. This route is useful when you want to know just what is
on the tape, e.g. which stations are present and their data
coverage etc. Only one output file called GTAPE OUTPUT
is created.
If ROUTE is 2, the package retrieves waveform data from a
GDSN tape, and many output files are created (see FILEs).

      MODE   HELP MANAGER

   The MODE switch informs the package of the data tape mode.
It is either 1 or 2 depending on the data recording date.
MODE is 1 for GDSN tapes containing data originally recorded
before 1.1.1980.
MODE is 2 for GDSN tapes containing data originally recorded
after 1.1.1980.

      TYPE   HELP MANAGER

   The TYPE switch indicates the type of data tape being read.
It is either 1 or 2.
TYPE is 1 for data tapes made from continuous running of a
Single station (e.g. Bergen DWWSSN data tapes coming direct
from Bergen).
TYPE is 2 for the Network-Day tapes coming from the U.S.

      RUN   HELP MANAGER

   The RUN switch controles the way the package is run.
It can be 1, 2 or 0.
If RUN is 1 the request lines for data retrievals are read
from the terminal and the user decides names for waveform data
files, this mode of the run is called INTERACTIVE RUN option.

*** INTERACTIVE RUN OPTION IS USEFUL FOR BEGINNERS !***

If RUN is 2 the request lines for data retrievals are read from
a file called GTAPE INPUT A which is usually made by program
MAKIN. In this case the waveform data files are named by the
package, this mode of run is called PRODUCTION RUN option.
(see also FILES in this Help Manager).
N.B. If RUN is 0 this Help Manager is called.

The GDSN package reads commands and instructions from Unit 5
and writes the standard output file to Unit 6. If waveform
data are retrieved, 7 extra output files are also generated.
These are as follows:

Filename	Filetype	Filemode	Unit	Comments
?******	SZ****	?	1	SPZ component
?******	LZ****	?	2	LPZ component
?******	LN****	?	3	LPN component
?******	LE****	?	4	LPE component
?******	IZ****	?	7	IPZ component
?******	IN****	?	8	IPN component
?******	IE****	?	9	IPE component

where the fixed Filetype prefixes (SZ, LZ, ...) are used
to indicate different components, the (?) show the position
of the Filename prefix and Filemode determined by the user.
The rest of the file specifications (denoted by *) are
determined either by the user (INTERACTIVE RUN) or by the
package (PRODUCTION RUN). So the user is free to choose
any name to replace the (*) if he is in the INTERACTIVE RUN,
for example a file like XTEST LNTEST A is acceptable.
    But if the user is in the PRODUCTION RUN mode, the package
will fill the (*) in the file specification with Origin time
of the event for which data retrieval is attempted. So, the
Origin time of the event in question must be given as input
to the package. This is done by starting with a program
called MAKIN. MAKIN will ask the user what stations he wants
and what type of waveform should be read, etc. Then it makes
input lines which are 160 characters long. The first 80 chara-
cters are standard request lines and the next 80 contain ISC
hypocentral information as well as distance and azimuth to
each station and the NORSAR tape number. In PRODUCTION RUN
an example of a waveform data file is S811224 LZ2236 B, which
is LPZ component for an event origin time of 1981 Dec. 24 at
22:36 GMT, and belongs to project S, and is on disk B.
    Note that some of these 7 files are not actually used
in most runs though they should be defined as shown above.
So, they are all assigned to a file called GTAPE DUMMY A and
are deleted at the end of each run.
    The way the package operates require a few steps in the
EXEC command and some DUMMY files are used to link various
steps. It is advisable not to change any of the file names
in the EXEC unless you are familiar with the package.

TAPEs   HELP MANAGER

   A GDSN data tape contains digitally recorded seismic data
from SRO, ASRO and DWWSSN stations.
The GDSN package is designed to read such tapes. If you are
running the package in the INTERACTIVE mode your data tape
should be mounted by now (or mount it just now!).
In the PRODUCTION RUN mode provided you use program MAKIN
to make your input file, the package will tell you which
NORSAR tape to mount before starting the run.

   INTEractive run   HELP MANAGER

   A useful policy in running GDSN package is to run it in
INTERACTIVE RUN first to get used to its functions. This
option is explained below.

      STEPS IN RUNNING GDSN PACKAGE IN INTERACTIVE RUN OPTION

      a) Choose your GDSN tape and load it on the IBM.

      b) Enter the following line at your terminal:
         GTAPE
         The package will assume an INTERACTIVE RUN mode, so
         remember to set the RUN switch to 1 when you are
         asked.

   PRODuction run   HELP MANAGER

   Once you are familiar with the GDSN package by practicing
a few INTERACTIVE RUNs, you may wish to retrieve your waveform
data using the PRODUCTION RUN option as suggested below.

      STEPS IN RUNNING GDSN PACKAGE IN PRODUCTION RUN OPTION

      a) Make an EVENT DATA file (at NORSAR this is done by
         running the package MERGE).
      b) This EVENT DATA file is essential for the next step
         and the index of each event on this file (i.e. the
         line number of each event) is used to identify each
         event.

      c) Enter the following line at your terminal :
         GTAPE EVENT RUNS INIT
         in which EVENT is the event index, RUNS is the number
         of events to do starting from EVENT, and INIT is a
         switch indicating you are at the start of the run.

EXECs   HELP MANAGER

The main EXEC command which operates the GDSN package is
GTAPE

GTAPE has the following forms:
a)   GTAPE   for INTERACTIVE RUN mode
b)   GTAPE   event runs init.   for PRODUCTION RUN mode
c)   GTAPE   event runs   for PRODUCTION RUN mode
where :
        event   is the event number to start with
        runs   is the number of events to read
        init   to indicate you are starting the run.

Appendix VI.5.2 - A practical users' guide to the GDSN software package

This section is intended for NORSAR only and it is assumed that the users are familiar with the NORSAR IBM 370 installation.

Note that GDSN needs at least 2M storage and uses VSLIB. So, set the storage to 2M and take the following steps:

1. Link to user 'GDSN SRO', and take a copy of the following files:
        GTAPEE EXEC
        GPLOTE EXEC
        GDISKE EXEC
        GDSN   EXEC
        DATA   EXEC
        DATAR   EXEC
        GDISK   FORTRAN
        GDSNDR FORTRAN
    Rename the first three files for your own use as follows:
        GTAPE   EXEC
        GPLOT   EXEC
        GDISK   EXEC
    but keep the last five files in their original names.

2. Enter the following line at your terminal:
        GTAPE
    and enter the Help Manager if you wish. Make yourself familiar with the package features. Then exit the package in any way you can.

3. Prepare a list of events for which you seek waveform data. This list must contain hypocentral information for your events in the following (self-explanatory) format:
        1981 SEP 2 NAO 92452.0 36.800N 140.600E 33 5.5
    and must be called 'EVENT DATA'.

4. Decide a one letter code called Filename prefix to identify your project, etc., and also decide a one letter code called Filemode for your virtual disk intended for waveform data. Say 'X' for the former and 'A' for the latter. Remember you can write on other users' files if the codes you select have already been used.

5. Suppose you wish to do 5 events starting from the first event on the EVENT DATA file. Enter the following line at your terminal:

    GTAPE 1 5 init

    and respond to package questions for your initialization set up. The package will then ask you to mount the first data tape by giving the NORSAR tape number. Your waveform data for the first event will be retrieved and plotted before you are asked for the next data tape and so on.

    Note that the key 'init' in the above command is for the initial run only. So, if you wish to do another 10 events starting from event 6, you only need to enter the following line:

    GTAPE 6 10

    and your original initialization set up is preserved for you.

6. You may use command GPLOT to make another set of plots for your waveform data. If you want to replot event 1, your Filename prefix is 'X', your Filemode identifier is 'A' and you have already retrieved LP data, then enter the following line at your terminal:

    GPLOT 1 X A LP

7. You may use command GDISK instead of GPLOT to use the program GDISK which you may wish to modify for your own use. The syntax of this command for the same example as in (6) above is:

    GDISK 1 X A LP

The FORTRAN programs GDISK and GDSNDR are the only ones you may need to modify for your own use. You will have to modify GDISK to branch to your own subroutines for data processing but modify GDSNDR only if you need instrument response information as well. Both GDSNDR and GDISK are well commented.