User Manual

Waveforms and response spectra are provided as Adaptable Seismic Data Format (ASDF) (https://seismic-data.org/) or as ASCII files (DYNA 1.2 format). Into ASDF and DYNA 1.2 formats, response spectra are evaluated at 105 periods from 0.01 to 10 seconds.

Details on ASDF structure are available in Krischer et al., 2016 (https://dx.doi.org/10.1093/gji/ggw319) (https://academic.oup.com/gji/article/207/2/1003/2583765). Response spectra are stored into ASDF volume in the *AuxiliaryData* structure. Browsing ASDF volumes is possible using many software (e.g. HDFView (https://support.hdfgroup.org/products/java/hdfview/), ASDF SEXTANT (https://github.com/SeismicData/asdf_sextant)) and many programming languages, e.g. Python using modules such as pyasdf (https://seismicdata.github.io/pyasdf/) or h5py (https://www.h5py.org/), MATLAB.

DYNA 1.2 ASCII format contains a 64 rows header and a data vector. Response spectra files contain pairs of period - ordinates.

1	EVENT_NAME	Name of the seismic event
2	EVENT_ID	Event ID in the database
3	EVENT_DATE_YYYYMMDD	Event date (YYYYMMDD), as GMT
4	EVENT_TIME_HHMMSS	Event origin time (hhmmss) , as GMT
5	EVENT_LATITUDE_DEGREE	Event Latitude (decimal degrees)
6	EVENT_LONGITUDE_DEGREE	Event Longitude (decimal degrees)
7	EVENT_DEPTH_KM	Event depth (km)
8	HYPOCENTER_REFERENCE	Hypocentre authoritative source
9	MAGNITUDE_W	Moment magnitude (Mw)
10	MAGNITUDE_W_REFERENCE	Moment magnitude authoritative source
11	MAGNITUDE_L	Local magnitude (ML)
12	MAGNITUDE_L_REFERENCE	Local magnitude authoritative source
13	FOCAL_MECHANISM	Focal mechanism (NF, SS, TF, U, oblique)
14	NETWORK	Network code
15	STATION_CODE	Station code
16	STATION_NAME	Station name
17	STATION_LATITUDE_DEGREE	Station Latitude (decimal degrees)
18	STATION_LONGITUDE_DEGREE	Station Longitude (decimal degrees)
19	STATION_ELEVATION_M	Station elevation (m.a.s.l.)
20	LOCATION	Flag indicating the location
21	SENSOR_DEPTH_M	Sensor depth (m, positive indicates below ground level)
22	VS30_M/S	Vs,30 (m/s)
23	SITE_CLASSIFICATION_EC8	EC8 site class. * indicates that site class is not based on a direct Vs,30 measurement
24	MORPHOLOGIC_CLASSIFICATION	Morphologic classification
25	EPICENTRAL_DISTANCE_KM	Epicentral distance (km)
26	EARTHQUAKE_BACKAZIMUTH_DEGREE	Earthquake backazimuth (degrees)
27	DATE_TIME_FIRST_SAMPLE_YYYYMMDD_HHMMSS	Time of the first sample (YYYYMMDD_hhmmss.dec), as GMT
28	DATE_TIME_FIRST_SAMPLE_PRECISION	seconds / milliseconds
29	SAMPLING_INTERVAL_S	Sampling interval (s)
30	NDATA	Number of observations
31	DURATION_S	Duration (s)
32	STREAM	Stream code (3 digits, i.e. HNE)
33	UNITS	Units (cm/s^2, cm/s, cm)
34	INSTRUMENT	Instrument (sensor and digitizer)
35	INSTRUMENT_ANALOG/DIGITAL	Flag to indicate whether the instrument is digital or analog
36	INSTRUMENTAL_FREQUENCY_HZ	Instrument Frequency (Hz)
37	INSTRUMENTAL_DAMPING	Instrument Damping
38	FULL_SCALE_G	Fullscale (g)
39	N_BIT_DIGITAL_CONVERTER	Number of bits of the Analog to Digital Converter
40	PGX_UNITS	PGA, PGV, PGD (cm/s^2, cm/s, cm)
41	TIME_PGX_S	Time corresponding to PGA, PGV, PGD
42	BASELINE_CORRECTION	BASELINE REMOVED / BASELINE NOT REMOVED
43	FILTER_TYPE	Filter type (Butterworth, etc.)
44	FILTER_ORDER	Filter order
45	LOW_CUT_FREQUENCY_HZ	Low-cut frequency value (Hz)
46	HIGH_CUT_FREQUENCY_HZ	High-cut frequency value (Hz)
47	LATE/NORMAL_TRIGGERED	LT/NT
48	DATABASE_VERSION	Database version at the time the waveform is processed
49	HEADER_FORMAT	Header version
50	DATA_TYPE	Data type (acceleration, velocity, displacement, acceleration response spectrum)
51	PROCESSING	Processing type and reference
52	DATA_TIMESTAMP_YYYYMMDD_HHMMSS	Date of file creation
53	DATA_LICENSE	License for data use
54	DATA_CITATION	Network or data citation
55	DATA_CREATOR	Creator of the processed file
56	ORIGINAL_DATA_MEDIATOR_CITATION	Citation of the intermediary of the original data
57	ORIGINAL_DATA_MEDIATOR	Intermediary of the original data
58	ORIGINAL_DATA_CREATOR_CITATION	Citation of the original data provider
59	ORIGINAL_DATA_CREATOR	Original data provider
60	USER1	Command line of the processing software
61	USER2	Free
62	USER3	Free
63	USER4	Free
64	USER5	Free

ASCII-file/ASDF-tag components

Following the Seed manual v 2.4 (https://www.fdsn.org/seed_manual/SEEDManual_V2.4.pdf), we adopt the following components:

- **net_code** is the FDSN network code (https://www.fdsn.org/networks/) (1 or 2 characters)

- **station_code** is the station code (3 to 5 characters)
- **location_code** is the code which indicates the station location (0 to 2 characters); in file names, the *location_code* '00' (double-zeros) is always replaced by an empty string
- **channel_code** indicates the instrument type and the ground-motion component and has 3 digits:
    - 1st digit for the band code (in our case H = High Broad Band i.e. sample rate within the range 80-250 Hz);
    - 2rd digit indicates the instrument code: N, L, G = accelerometer (the codes are the ones used as a convention by many networks),
    - 3th digit indicates the orientation code: e.g. Z N E (traditional Vertical, North-South, East-West), Z 2 3 (orthogonal components but nontraditional orientations), etc.

Other specific components are:

event_id is the event identifier

date is the event date as "YYYYMMDD"

time is the event origin time as "hhmmss"

file_type is either ACC (acceleration), VEL (velocity) or DIS (displacement) for time series, as well as SA (acceleration) or SD (displacement) for response spectra.

processing_type is either MP or AP (Manual or Automatic processing using the schema by Paolucci et al, 2011) or CV (unprocessed accelerations ConVerted in physical units). Details on the automatic processing can be found in Puglia et al., 2018.

processing_type_old is either X (unprocessed, that is the same as the above 'CV') or C (processed, same as above 'MP' or 'AP').

ASCII file naming

The ASCII files can be downloaded with two filenames:

Default filename:

'net_code'.'station_code'.'location_code'.'channel_code'.**D**.'event_id'.'file_type'.'processing

Old filename: adopted in the previous versions ITACA 2.X:

'net_code'.'station_code'.'location_code'.'channel_code'.**D**.'date'.'time'.'processing_type_o

ASDF tag naming

'location_code'_'channel_code'_'event_id'_'processing_type'_'file_type'

- all characters in lower-case
- not alphanumeric characters of 'event_id' are replaced by underscores

Examples:

The unprocessed acceleration time serie recorded by the Department of Civil Protection network (IT) at San Giuliano di Puglia station (station code SGIUB), location '00',component N, event ID 'IT-2002-0075' (occurred on 2002/11/12 at 09:27:48 GMT), assumes the following names:

ASCII default filename: **IT.SGIUB..HNN.D.IT-2002-0075.CV.ACC.ASC**

ASCII old filename: **IT.SGIUB..HNN.D.20021112.092700.X.ACC.ASC**

ASDF tag: **00_hnn_it_2002_0075_acc_cv**

References

Lion Krischer, James Smith, Wenjie Lei, Matthieu Lefebvre, Youyi Ruan, Elliott Sales de Andrade, Norbert Podhorszki, Ebru Bozdağ, Jeroen Tromp; An Adaptable Seismic Data Format, Geophysical Journal International, Volume 207, Issue 2, 1 November 2016, Pages 1003–1011, https://doi.org/10.1093/gji/ggw319

Paolucci R., Pacor F., Puglia R., Ameri G., Cauzzi C., Massa M. (2011). It appears as chapter 8 of the book Earthquake Data in Engineering Seismology - Predictive Models, Data Management and Networks by Sinan Akkar, Polat Gülkan, Torild van Eck (Editors). ISBN: 978-94-007-0151-9 (Printed version) 978-94-007-0152-6 (E-book version). This book is volume 14 of the series Geotechnical, Geological, and Earthquake Engineering, published by Springer Netherlands in 2011.

Puglia, R., Russo, E., Luzi, L., D'Amico, M., Felicetta, C., Pacor, F., & Lanzano, G. (2018). Strong-motion processing service: a tool to access and analyse earthquakes strong-motion waveforms. Bulletin of Earthquake Engineering, 16(7), 2641-2651.