

(200)  
R290  
no. 81-448

X

United States Department of the Interior  
Geological Survey

Seismic Engineering Data Report

PROCESSED ACCELEROGRAMS FROM MONTICELLO DAM  
JENKINSVILLE, SOUTH CAROLINA  
27 AUGUST 1978, AND TWO LATER SHOCKS

by

A. G. Brady, P. N. Mork, and J. P. Fletcher

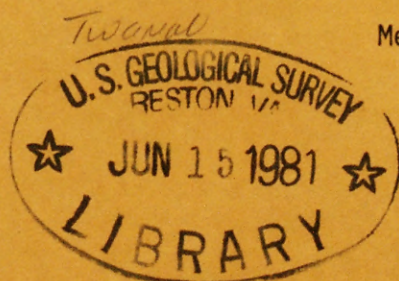
OPEN-FILE REPORT 81-0448

Prepared on behalf of the National Science Foundation

Grant CA-114

314282

This report is preliminary and has not been reviewed  
for conformity with U.S. Geological Survey editorial standards.  
Any use of trade names is for descriptive purposes only  
and does not imply endorsement by the USGS.



Menlo Park, California

March, 1981



## CONTENTS

	Page
Monticello Dam Record Processing.....	1
Appendix.....	6
Tables from USGS Circular 985B	
Accelerograms	
Response Spectra	



## Monticello Dam Record Processing

### Summary

This report serves two purposes: The documentation of a digital magnetic tape containing the results of processing the strong-motion data from Monticello Dam, South Carolina, during a series of three events in 1978, and the reproduction of the more important graphical results.

Only one event is identified: 27 August 1978; 1023 UTC; coordinates 34.31N, 81.33W; depth 1.5 km; magnitude 2.7 (Porcella, 1978). The second and third events occurred during the period from 31 August 1978 to 6 November 1978 (figure 1). On this section of the original film record a total of eight events were recorded. The two selected for this processing package had peak horizontal accelerations, scaled from the records, of 0.22 and 0.24 g. The identified event had a peak of 0.25 g, the largest known recorded acceleration from an earthquake in central or eastern North America.

Monticello Dam is made up of four sections of embankment as shown in the map of figure 2; the instrument is installed in a small plywood shelter on the south abutment of the largest of these four. The intake to a powerhouse shares this central abutment area.

The coordinates of the station are 34.30N, 81.33W, and the epicentral distance from the identified shock is about 1 km. The sources for the two aftershocks are also very near the recording station, for there is no evidence of S-trigger intervals.

Digitizing of the three recordings was carried out by IOM-TOWILL of Santa Clara, California, and USGS processing of the data has resulted in plots of the accelerations at three stages of correction, corrected velocity and displacement, and response spectra. The results of corrected data only are

available on magnetic tape from the Environmental Data and Information Service, NOAA, in Boulder, Colorado, 80302; phone (303) 499-1000, extension 6473. This report contains computer plots of the data on the tape, and the response spectra tripartite plots.

#### Digitization and processing

These records provided us with the first opportunity to make special arrangements for handling very high frequency content. The first digitization of the 27 August 1978 record had been processed with the standard high frequency treatment, namely interpolation at 200 points per second, filtering at 25 Hz, and outputting data at 100 points per second. Because these records have frequencies as high as 25 and 30 Hz, it was not surprising that the results were unsatisfactory, including the reduction of peak values by as much as 50 percent. The results of the revised processing are shown in the plots in the appendix. "Raw data" signifies the input to the correction scheme, and corresponds to uncorrected data of Caltech and USGS processing. These data are then interpolated at 0.002 sec, or 500 points/second, and the plot is labelled Interpolated/decimated. Butterworth filters whose corner frequencies are 3 db down are used to band-pass the interpolated data between the low frequency limit of 2 Hz ( $n = 1$ , first order) and 50 Hz (with  $n = 2$ , second order). These plots are labelled Filtered/windowed. The second page of plots for each component contains the acceleration, velocity and displacement with the instrument correction applied. All plots are scaled so that the peak value fills the vertical axis.

The tripartite response spectra contain plots from 2 to 25 Hz, that is 0.04 to 0.5 sec. The displacements that are asymptotically approached at the longer periods of this range correspond well with the maximum displacements indicated in the plots of the displacement time series. On the other hand,



the asymptotic approach to the peak acceleration at short periods occurs outside the plotted range.

#### Tape format

The tape delivered to EDIS, Boulder, Colorado for dissemination purposes contains three files:

1. Corrected acceleration, velocity, and displacement, as described above, for the earthquake of 27 August 1978, 1023 UTC; Monticello Dam, center crest; filtered from 2 to 50 Hz; three components.
2. Same data for the record indicated by "Aftershock No. 1".
3. Same data for the recording indicated by "Aftershock No. 2".

The tape characteristics are: Blocked, fixed length, 80 byte card image, 2000 byte block size (that is 25 cards), unlabelled, 9-track, 800 bpi, ASCII.

#### References

Porcella, R. L., 1978, Seismic Engineering Report May - August 1978, U.S. Geological Survey Circular 985-B.

U.S. STRONG-MOTION NETWORKDIRECTION\*CONSTANTSStation No. Temp. 34.30N, 81.33W

180°

Sens. = 1.90 cm/g

Per. = .040 sec

Damp. = 0.60 crit

Jenkinsville, S.C. Monticello Dam

SMA-1 No. 603 Shared Abut (Center Crest)

Up

Sens. = 1.75 cm/g

Per. = .040 sec

Damp. = 0.60 crit

EARTHQUAKE OF (Main Event)

27 August 1978, 0523 EST

27 August 1978, 1023 UTC

090°

Sens. = 1.75 cm/g

Per. = .038 sec

Damp. = 0.60 crit

①

U.S. STRONG-MOTION NETWORKDIRECTION\*CONSTANTSStation No. Temp 34.30N, 81.33W

180°

Sens. = 1.90 cm/g

Per. = .040 sec

Damp. = 0.60 crit

Jenkinsville, S.C. Monticello Dam

SMA-1 No. 603 Shared Abut. (Center Crest)

Up

Sens. = 1.75 cm/g

Per. = .040 sec

Damp. = 0.60 crit

EARTHQUAKE OF Between

31 August 1978 and

6 November 1978 (8 events)

090°

Sens. = 1.75 cm/g

Per. = .038 sec

Damp. = 0.60 crit

\*Azimuthal direction of case acceleration for upward trace deflection

②

③

Figure 1.- Original records.

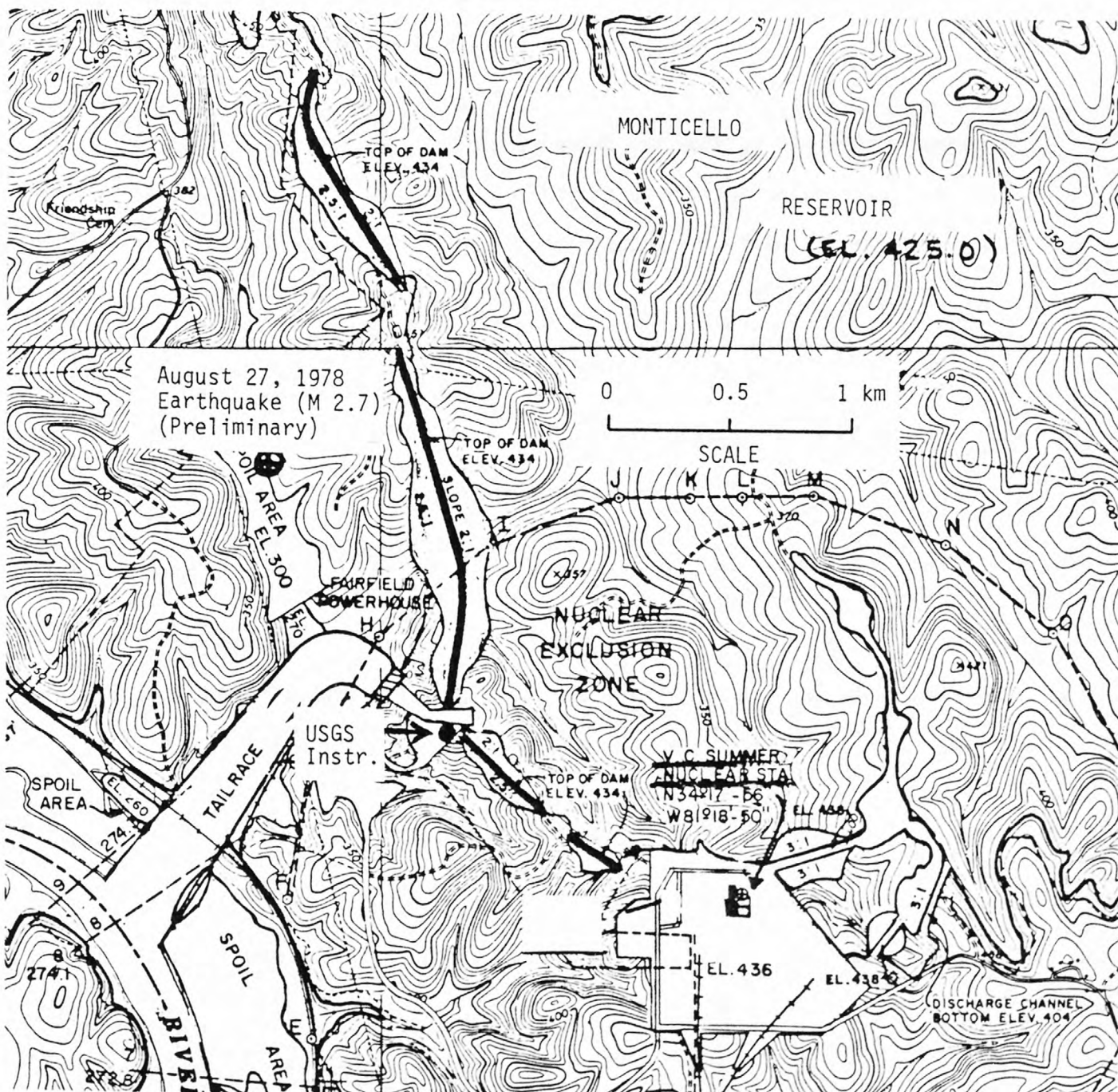


Figure 2.- Monticello Dam, USGS instrument location, and identified event epicenter.



## Appendix

The appendix contains three items:

1. A copy of pages 17 and 18 from U.S.G.S. Circular 985-B, detailing the description of the three events, as indicated.
2. Three stages of processing the accelerogram, and the corrected acceleration velocity, and displacement for each of the nine components:

Raw data: This is the raw input to the correction processing, and is equivalent to the volume I uncorrected data from Caltech and USGS.

Interpolated/decimated: Interpolation at 0.002 seconds, with no subsequent decimation, nor prior removal of points lying close to straight line segments.

Filtered/windowed: Band-passed from 2 Hz, with Butterworth  $n = 1$ , to 50 Hz ( $n = 2$ ) using only just greater than 3 seconds of the record.

Acceleration: Instrument correction applied .

Velocity: Direct integration of acceleration, together with straight line removal.

Displacement: Direct integration of velocity.

3. Response spectra for the nine components.

Table 1.- Summary of accelerograms recovered during May - August, 1978 - Continued

Event	Station name (owner) <sup>1</sup>	Station coord.	S-t <sup>2</sup> (s)	Accl direction <sup>3</sup>	Max accl <sup>4</sup> (g)	Duration <sup>5</sup> (s)
	Goleta, Calif	34.47 N	2.4	090°	0.24	1.0
	Glen Annie Rd	119.89 W		Up	.08	-
	(SCE)			360°	.28	1.8
Note: A small aftershock was recorded at U.C. Santa Barbara Physical Plant and Santa Barbara Courthouse. Maximum acceleration less than 0.05 g. Two seismoscope records were recovered at UCSB and Santa Barbara Courthouse; maximum relative displacements are 4.06 and 3.42 cm, respectively.						
27 August 1978	Jenkinsville, S.C.	34.30 N				
1023 UTC	Monticello Dam	81.33 W				
Jenkinsville, S.C.	(USGS) <sup>†</sup>					
34.31N, 81.33W	Shared abutment		-	180°	.25	0.06
Magnitude 2.7	(Center crest)			Up	.08	-
				090°	.20	.16
					**	
			-	180°	.08	-
				Up	.04	-
				090°	.06	-
31 August 1978-	Jenkinsville, S.C.	34.30 N				
6 November 1978	Monticello Dam	81.33 W				
Jenkinsville, S.C.	(USGS)					
Epicenters and	Shared abutment		-	180°	.06	-
magnitudes unknown	(Center crest)			Up	.03	-
				090°	.06	-
			-	180°	.07	-
				Up	.03	-
				090°	.10	1-peak
			-	180°	.04	-
				Up	.03	-
				090°	.06	-
			-		**	
			-	180°	.05	-
				Up	.05	-
				090°	.12	1-peak
			-	180°	.08	-
				Up	.06	-
				090°	.09	-

①

See footnotes at end of table.

Table 1.- Summary of accelerograms recovered during May - August, 1978 - Continued

Event	Station name (owner) <sup>1</sup>	Station coord.	S-t <sup>2</sup> (s)	Accl direction <sup>3</sup>	Max accl <sup>4</sup> (g)	Duration <sup>5</sup> (s)
			-	180° Up 090°	0.22 .11 .16	0.1 1-peak 0.1
			-	180° Up 090°	.13 .17 .24	0.3 0.2 0.3

- <sup>1</sup> ACOE - U.S. Army Corps of Engineers  
 CDMG - California Division of Mines and Geology  
 MWD - Metropolitan Water District  
 SCE - Southern California Edison  
 USBR - U.S. Bureau of Reclamation  
 USGS - U.S. Geological Survey

+ - WWVB time code is incomplete or nonexistent; correlation of accelerogram with event is questionable.

- <sup>2</sup> S-wave minus trigger time.

\*Denotes S-P interval, that is, the earthquake occurred within the instrumental run-time of a previous event.

- <sup>3</sup> Azimuthal direction of case acceleration for upward trace deflection on accelerogram (opposite direction to pendulum motion). Case acceleration for vertical component indicated as up or down.

- <sup>4</sup> Unless otherwise noted, maximum acceleration recorded at ground or basement level.  
 \*\* denotes maximum acceleration is less than 0.05 g at ground stations or less than 0.10 g at upper floors of buildings.

- <sup>5</sup> Duration for which peaks of acceleration exceed 0.10 g.

②

③

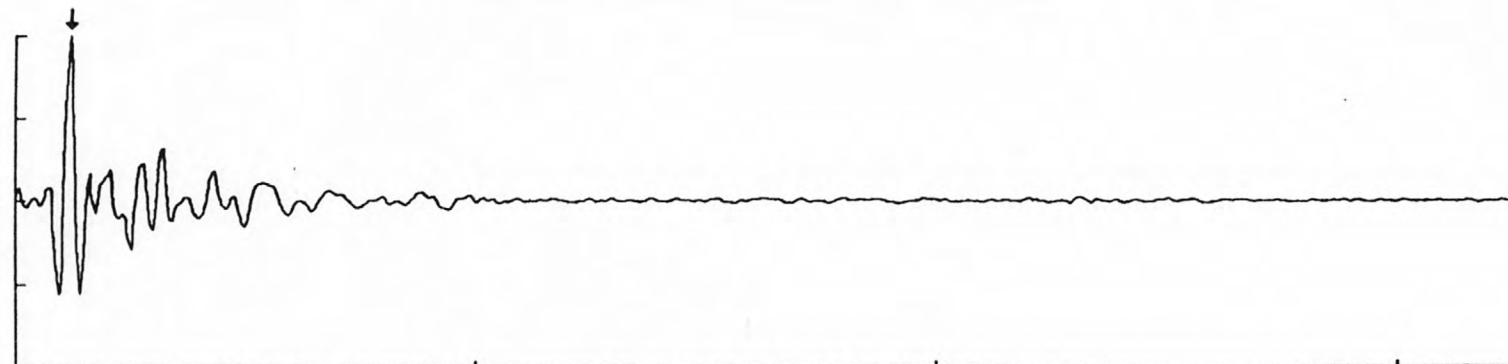


# EARTHQUAKE OF 27AUG78 - 1023 UTC

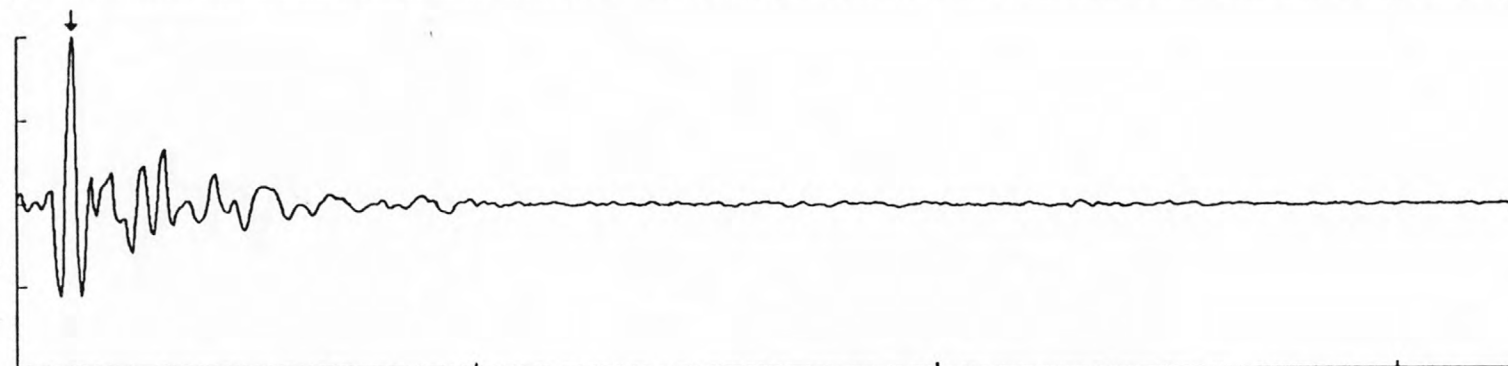
MONTICELLO CEN CREST, 8/27/78, 1023 UTC, 180 DEG

PEAK VALUES: RAW= 2.685 (G/10), INTERP= 256.3, FILTERED= 253.1 (CM/SEC/SEC)

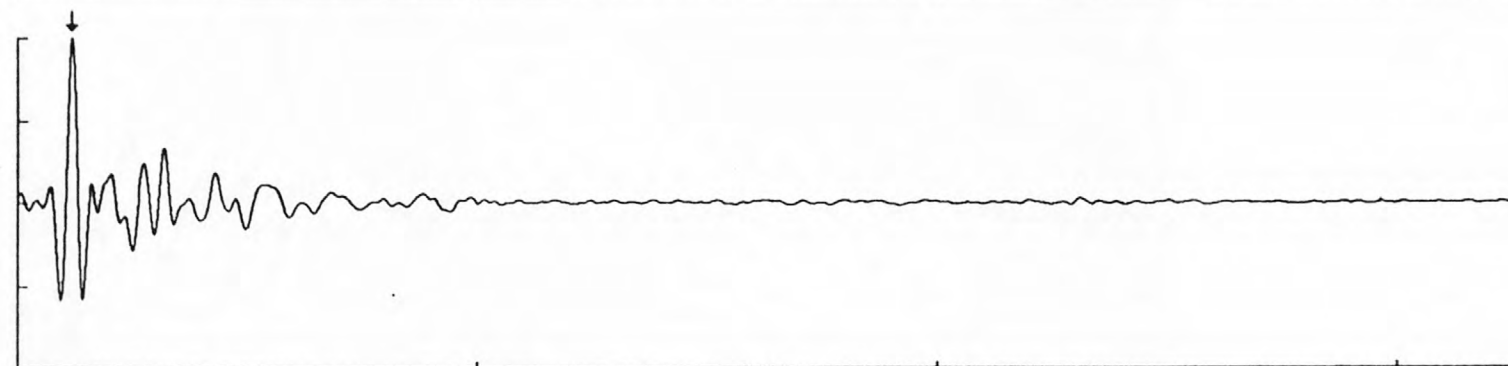
RAW DATA



INTERPOLATED/  
DECIMATED



FILTERED/  
WINDOWED

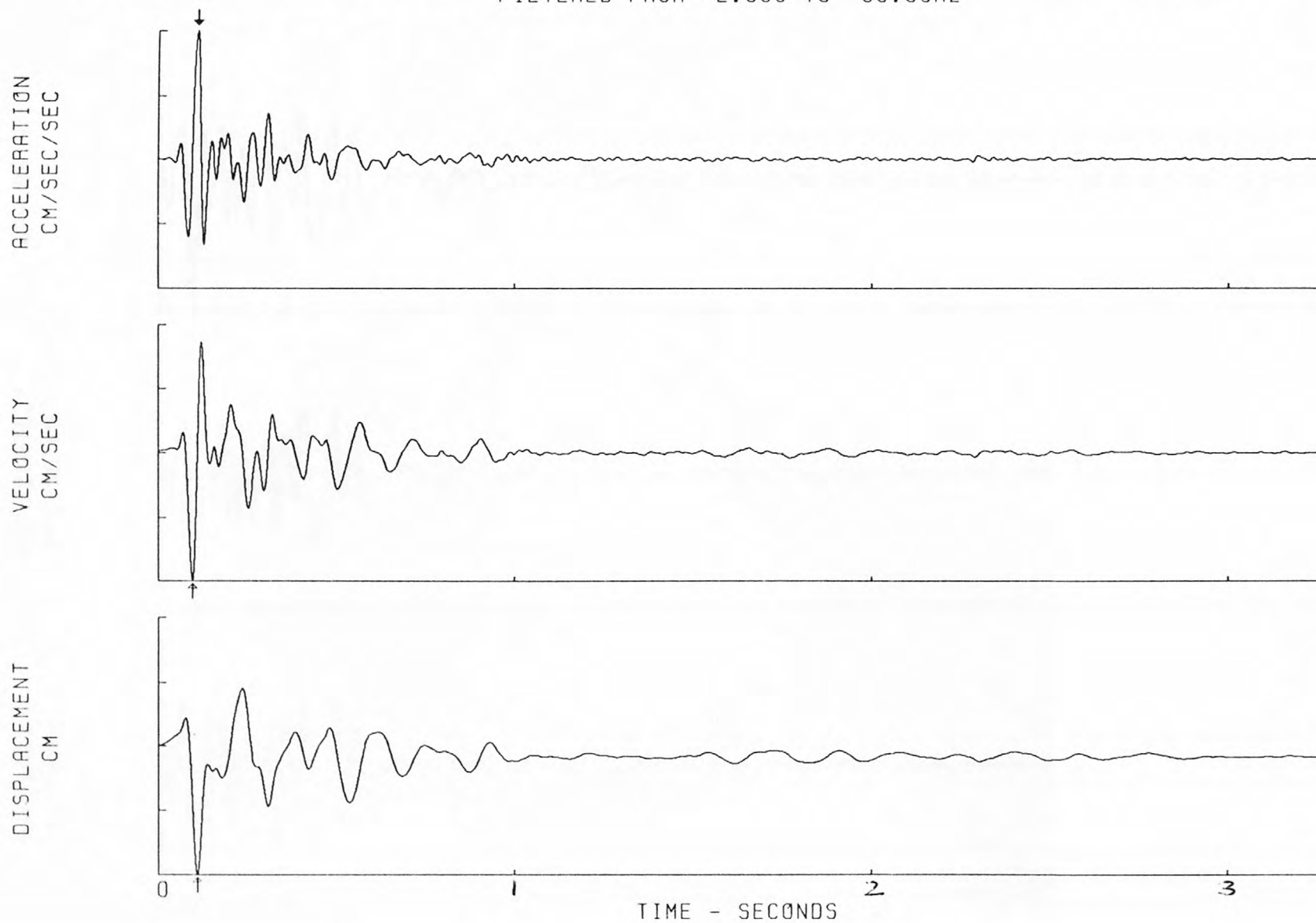


TIME - SECONDS

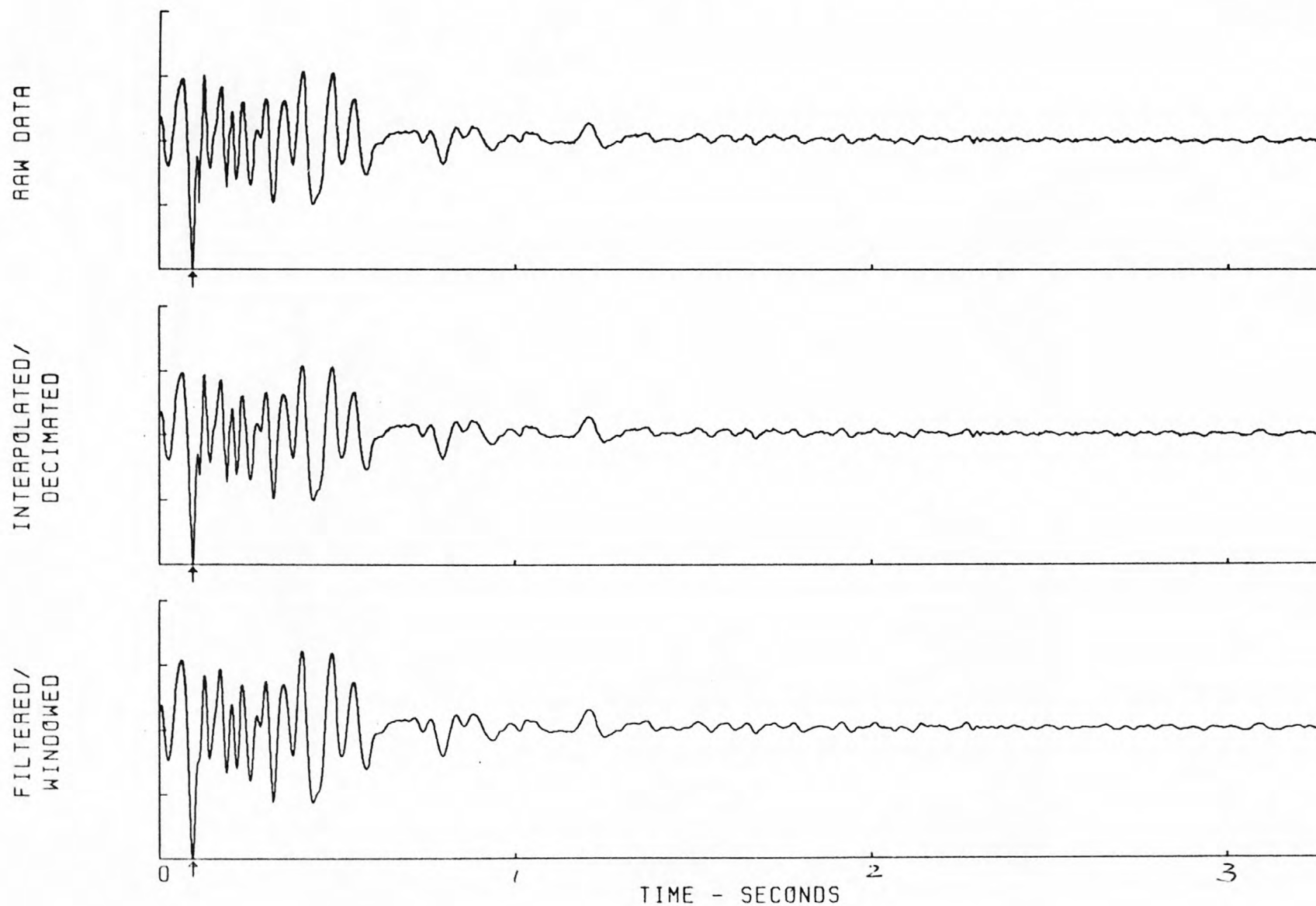
# EARTHQUAKE OF 27AUG78 - 1023 UTC

MONTICELLO CEN CREST, 8/27/78, 1023 UTC, 180 DEG

↑ PEAK VALUES: ACCEL= 261.4 CM/SEC/SEC, VELOCITY= -2.27 CM/SEC, DISPL= -0.04 CM  
FILTERED FROM 2.000 TO 50.00HZ



EARTHQUAKE OF 27AUG78 - 1023 UTC  
MONTICELLO CEN CREST, 8/27/78, 1023 UTC, UP  
PEAK VALUES: RAW= -0.82 (G/10), INTERP= -79.1, FILTERED= -70.7 (CM/SEC/SEC)

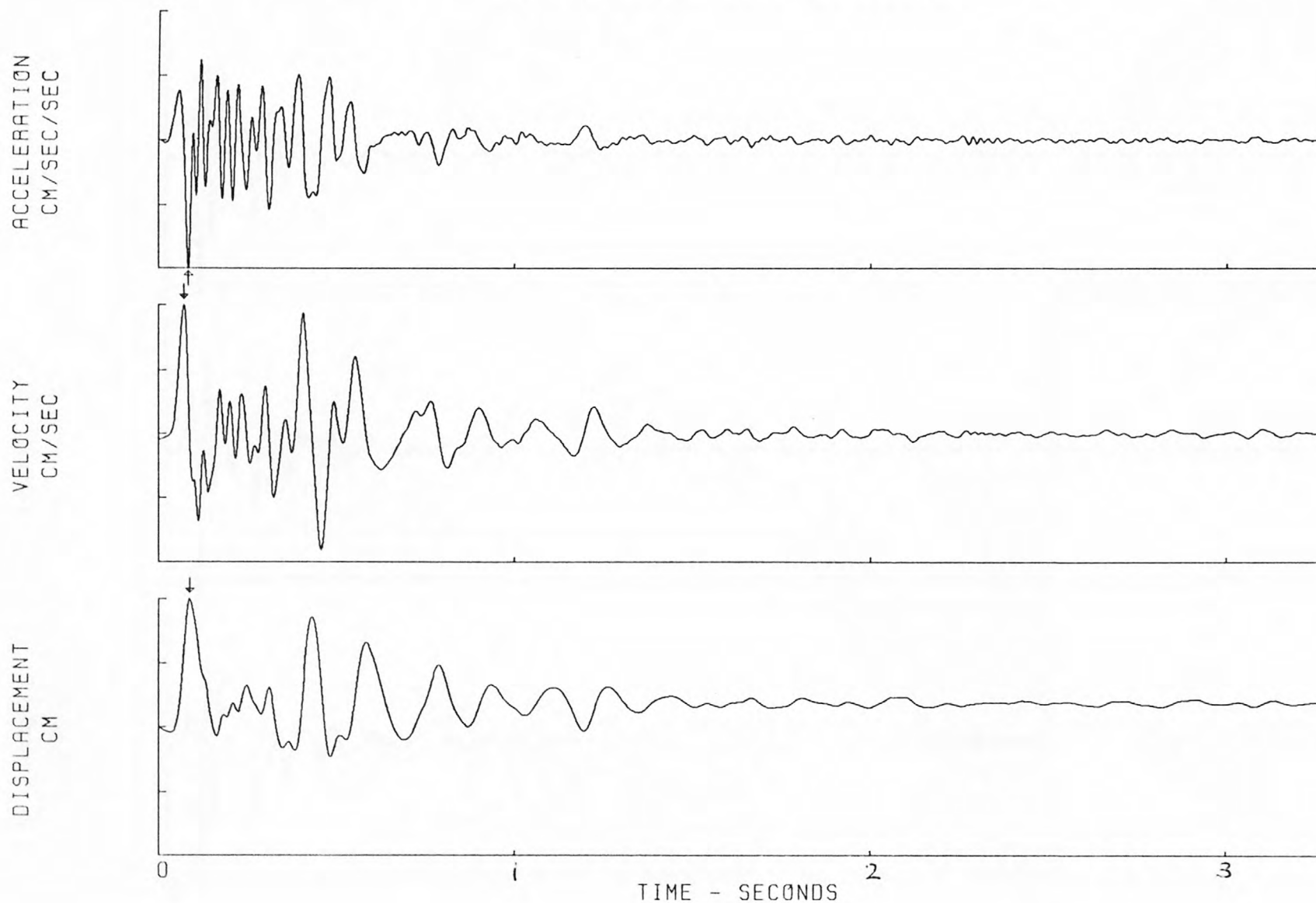




# EARTHQUAKE OF 27AUG78 - 1023 UTC

MONTICELLO CEN CREST, 8/27/78, 1023 UTC, UP

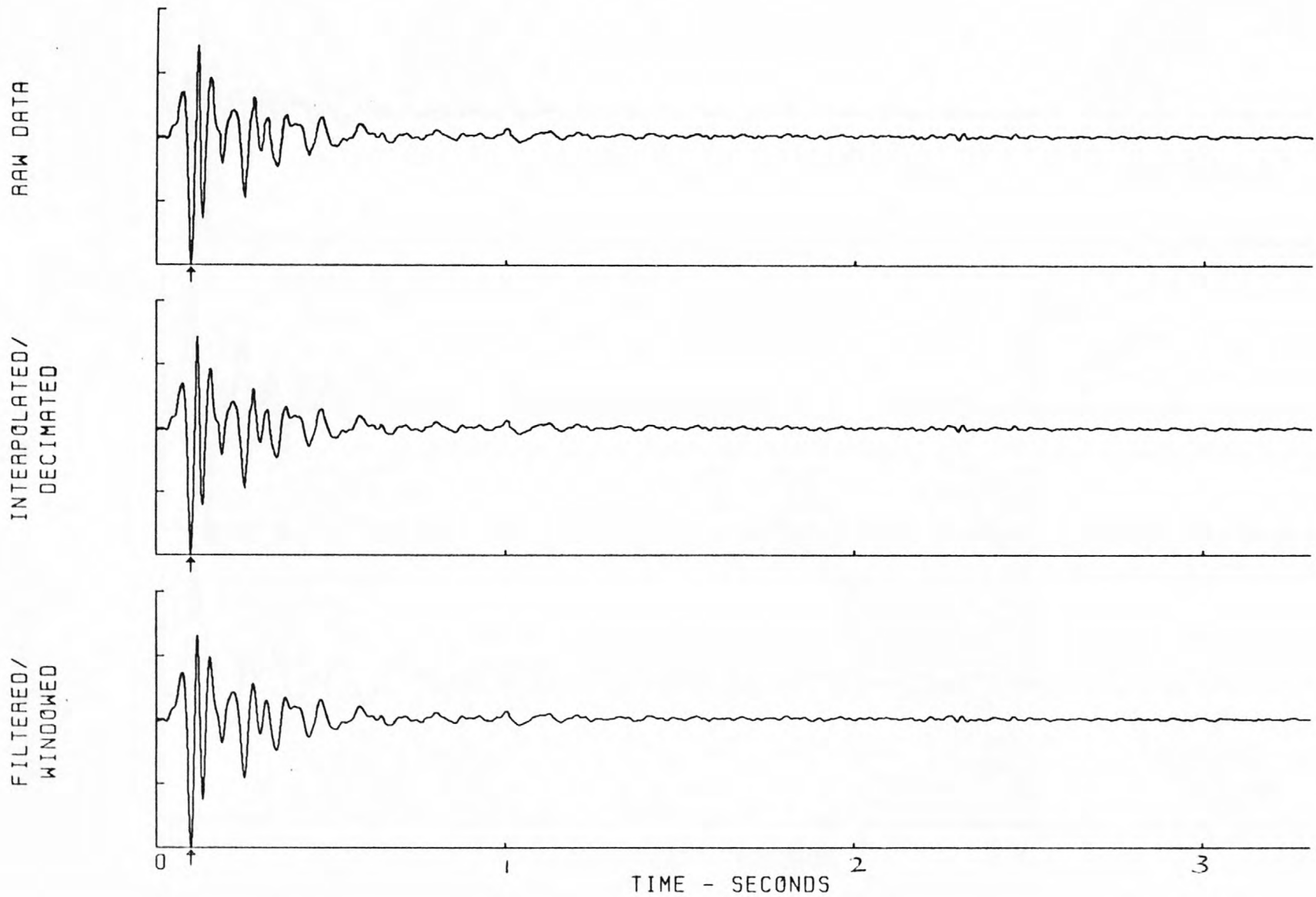
↑ PEAK VALUES: ACCEL = -82.2 CM/SEC/SEC, VELOCITY = 0.780 CM/SEC, DISPL = 0.020 CM  
FILTERED FROM 2.000 TO 50.00HZ



# EARTHQUAKE OF 27AUG78 - 1023 UTC

MONTICELLO CEN CREST, 8/27/78, 1023 UTC, 90 DEG

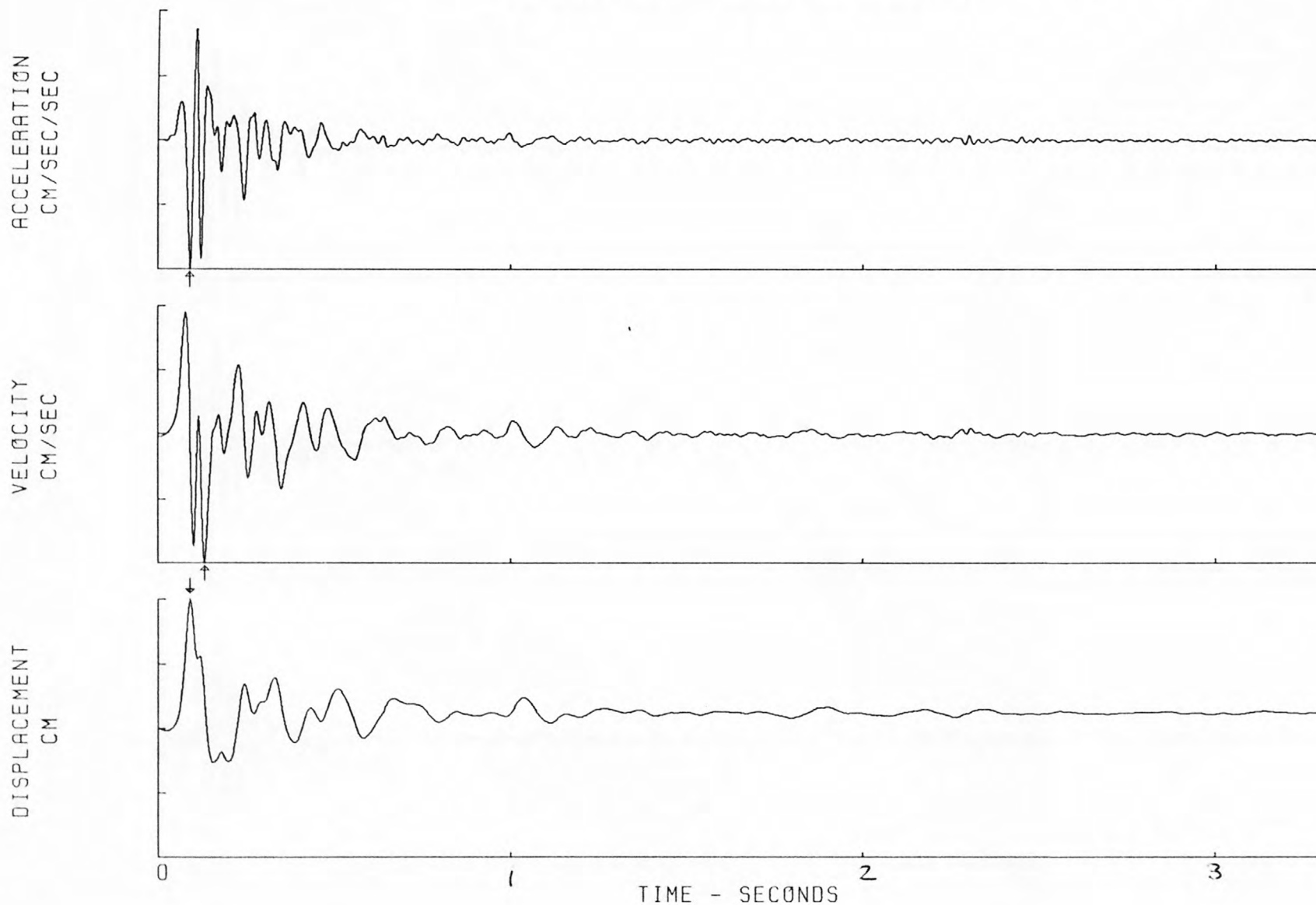
PEAK VALUES: RAW= -2.10 (G/10), INTERP= -206., FILTERED= -196. (CM/SEC/SEC)



EARTHQUAKE OF 27AUG78 - 1023 UTC

MONTICELLO CEN CREST, 8/27/78, 1023 UTC, 90 DEG

↑ PEAK VALUES: ACCEL= -220. CM/SEC/SEC, VELOCITY= -1.69 CM/SEC, DISPL= 0.040 CM  
FILTERED FROM 2.000 TO 50.00HZ



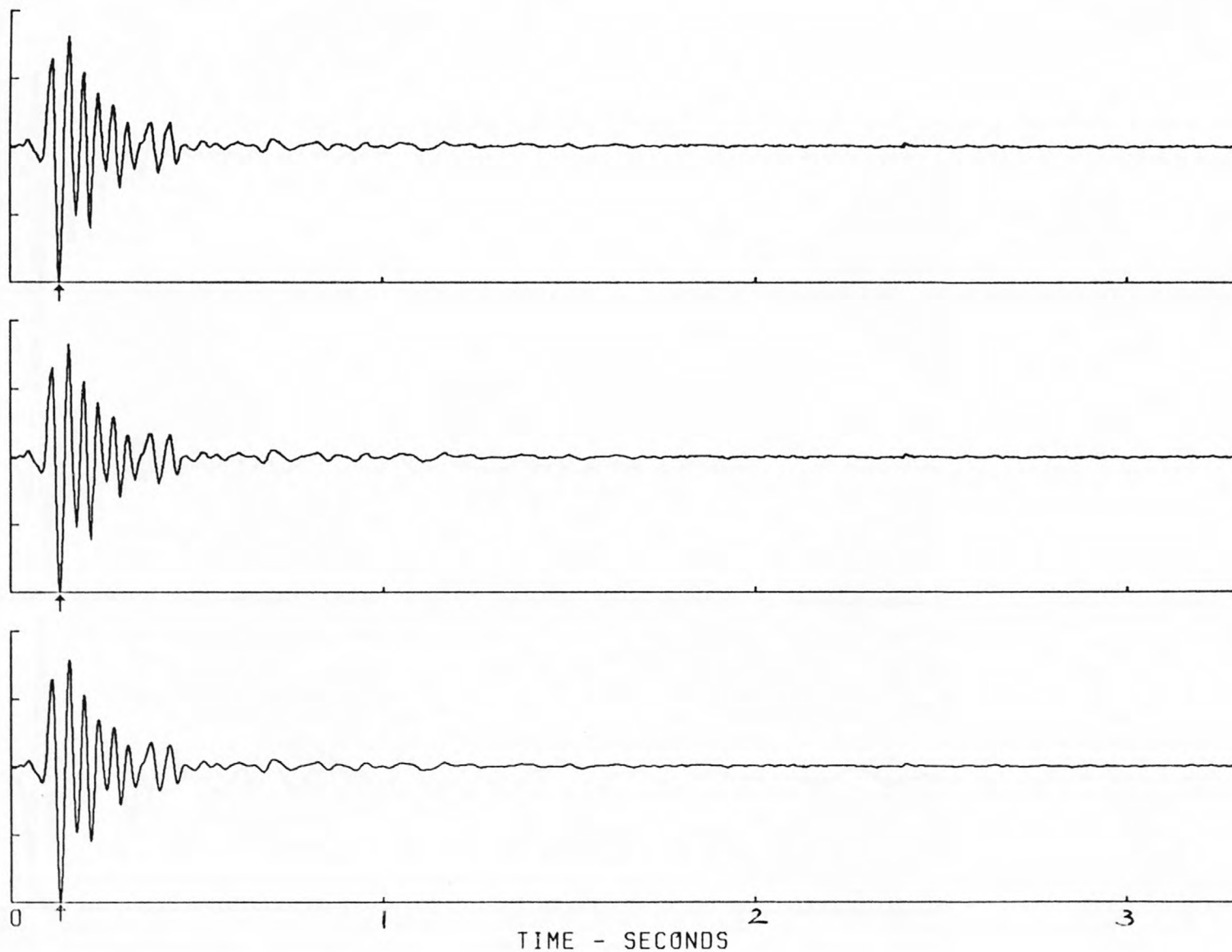


1ST AFTERSHOCK OF 27AUG78 - 1023 UTC EVENT  
MONTICELLO CEN CREST. 8/01/78 AFTERSHCK N01.180 DEG  
PEAK VALUES: RAW= -2.27 (G/10), INTERP= -218., FILTERED= -218. (CM/SEC/SEC)

RAW DATA

INTERPOLATED/  
DECIMATED

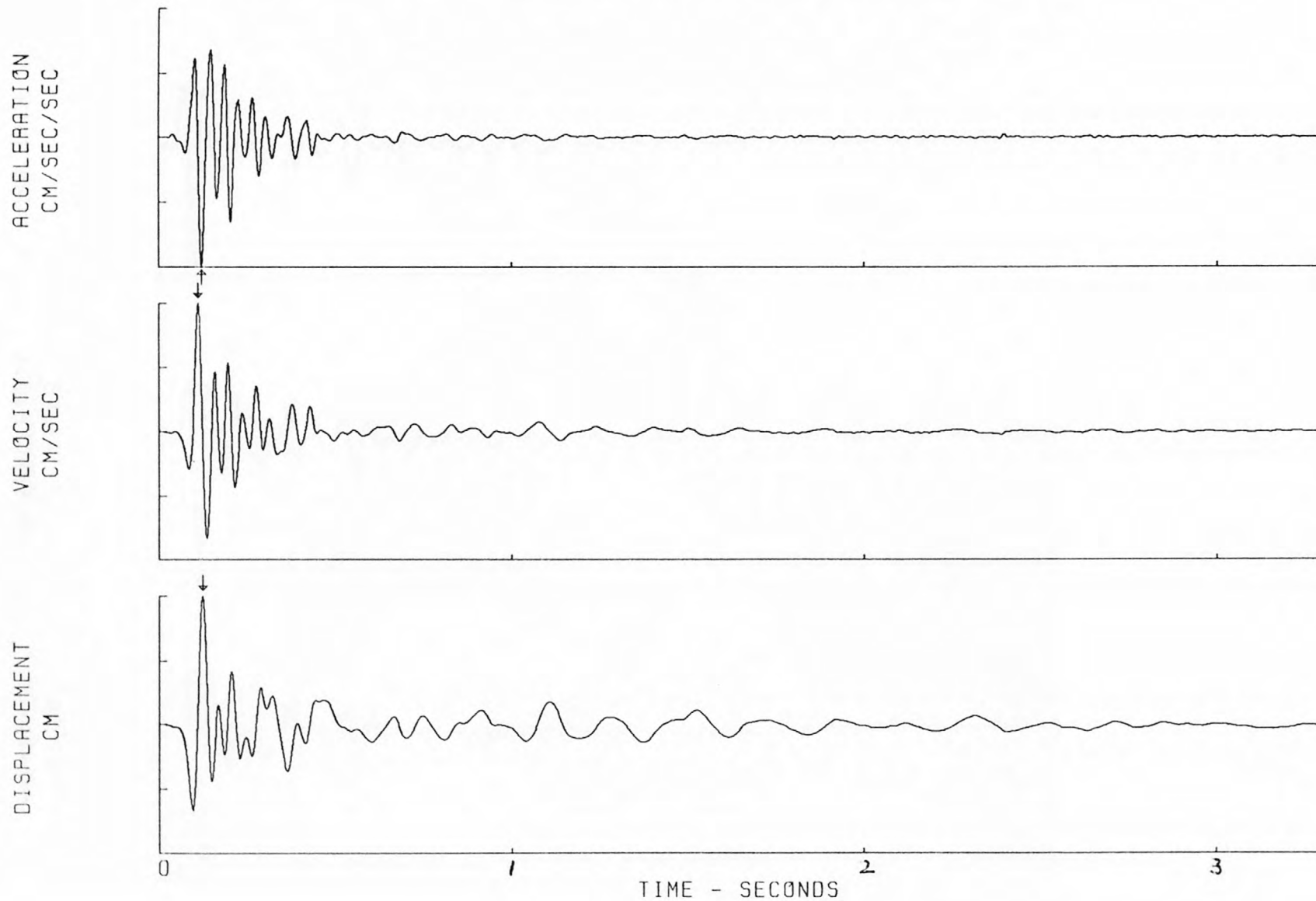
FILTERED/  
WINDOWED



# 1ST AFTERSHOCK OF 27AUG78 - 1023 UTC EVENT

MONTICELLO CEN CREST, 8/01/78 AFTERSHCK NO1, 180 DEG

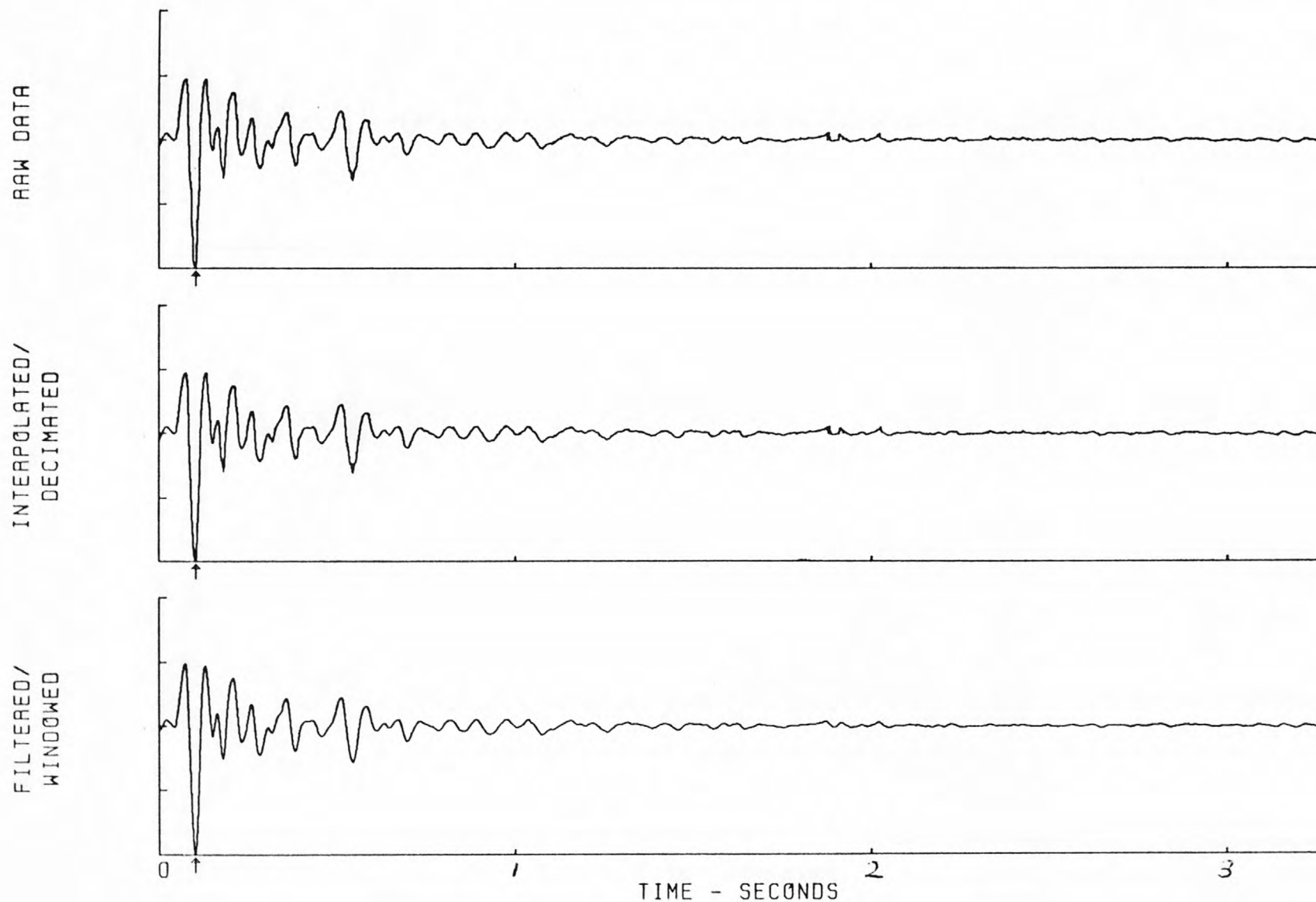
↑ PEAK VALUES: ACCEL= -256. CM/SEC/SEC, VELOCITY= 1.926 CM/SEC, DISPL= 0.018 CM  
FILTERED FROM 2.000 TO 50.00HZ



# 1ST AFTERSHOCK OF 27AUG78 - 1023 UTC EVENT

MONTICELLO CEN CREST, 8/01/78 AFTASHCK N01, UP

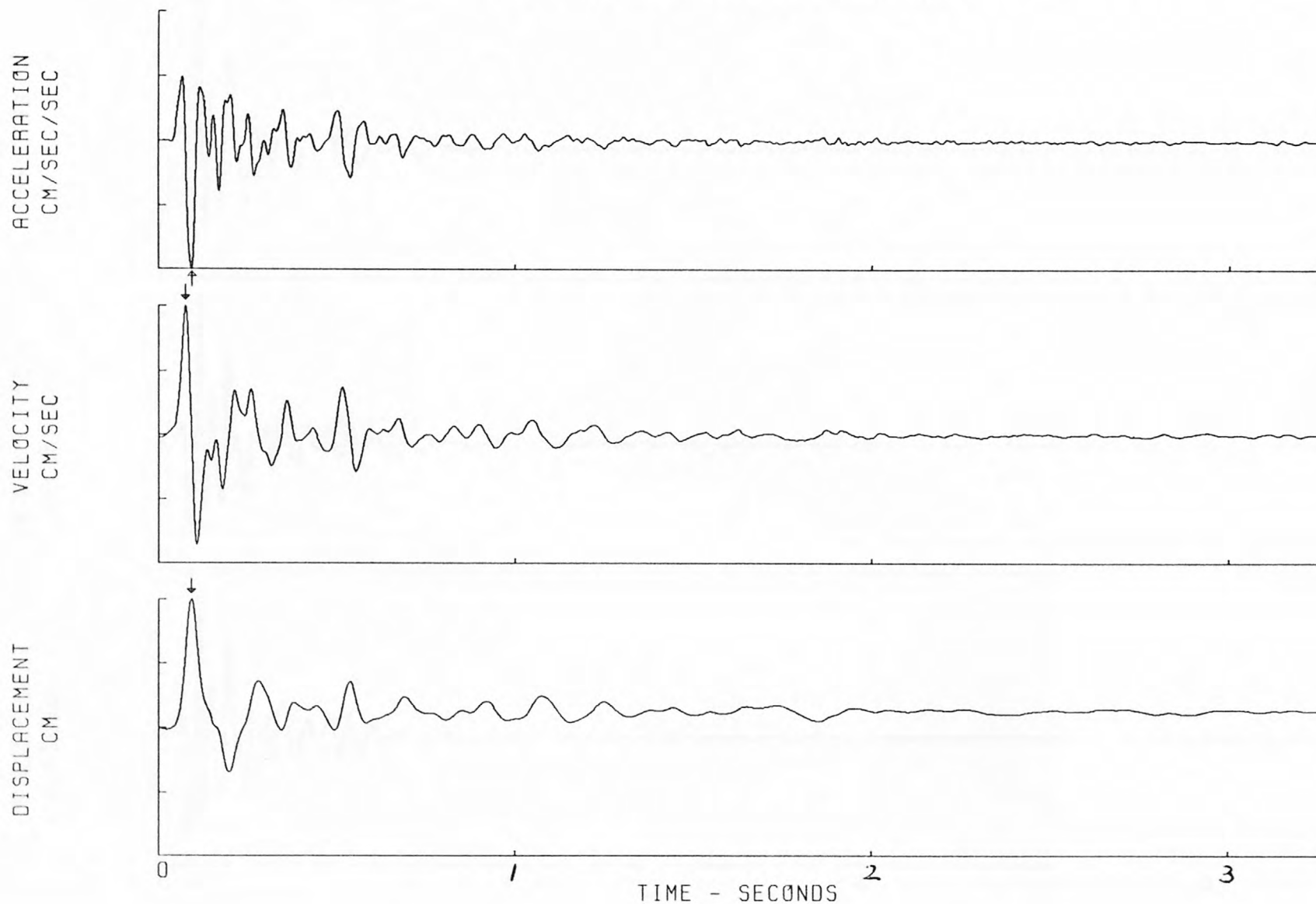
PEAK VALUES: RAW= -1.04 (G/10), INTERP= -102., FILTERED= -103. (CM/SEC/SEC)



1ST AFTERSHOCK OF 27AUG78 - 1023 UTC EVENT

MONTICELLO CEN CREST, 8/01/78 AFTASHCK N01, UP

↑ PEAK VALUES: ACCEL= -99.9 CM/SEC/SEC, VELOCITY= 1.087 CM/SEC, DISPL= 0.027 CM  
FILTERED FROM 2.000 TO 50.00HZ

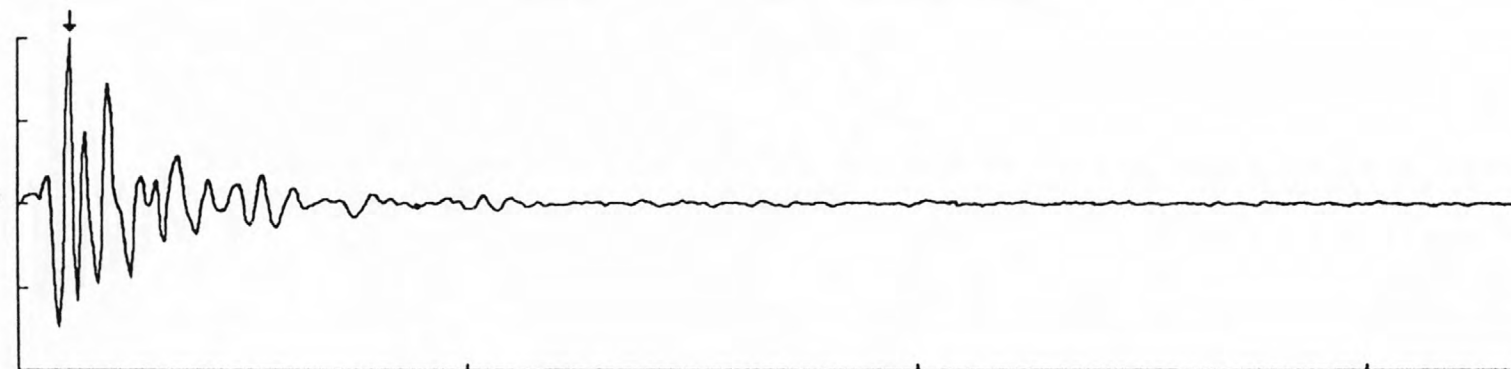


# 1ST AFTERSHOCK OF 27AUG78 - 1023 UTC EVENT

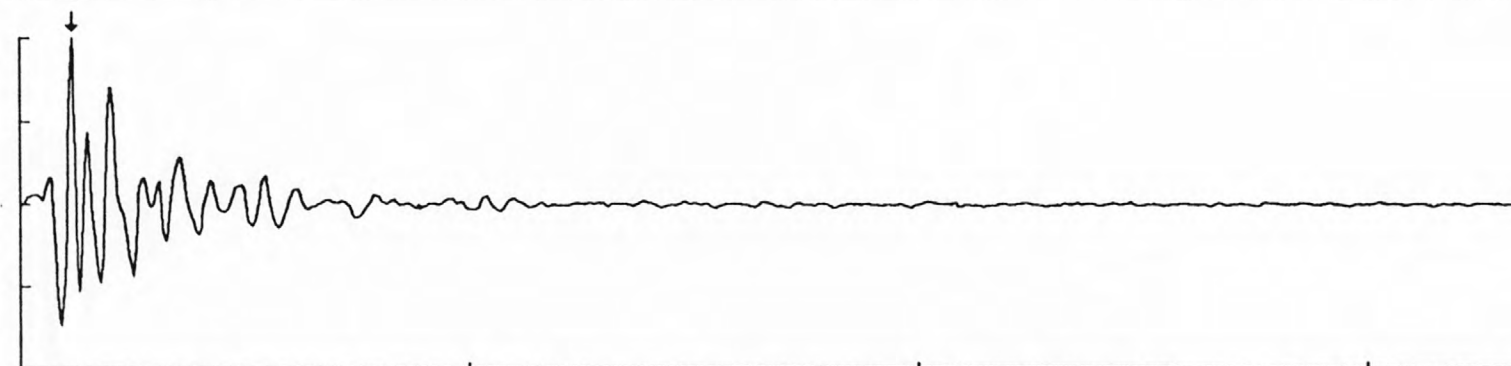
MONTICELLO\_CEN\_CREST, 8/01/78 AFTASHCK NO1, 90 DEG

PEAK VALUES: RAW= 1.640 (G/10), INTERP= 160.8, FILTERED= 151.7 (CM/SEC/SEC)

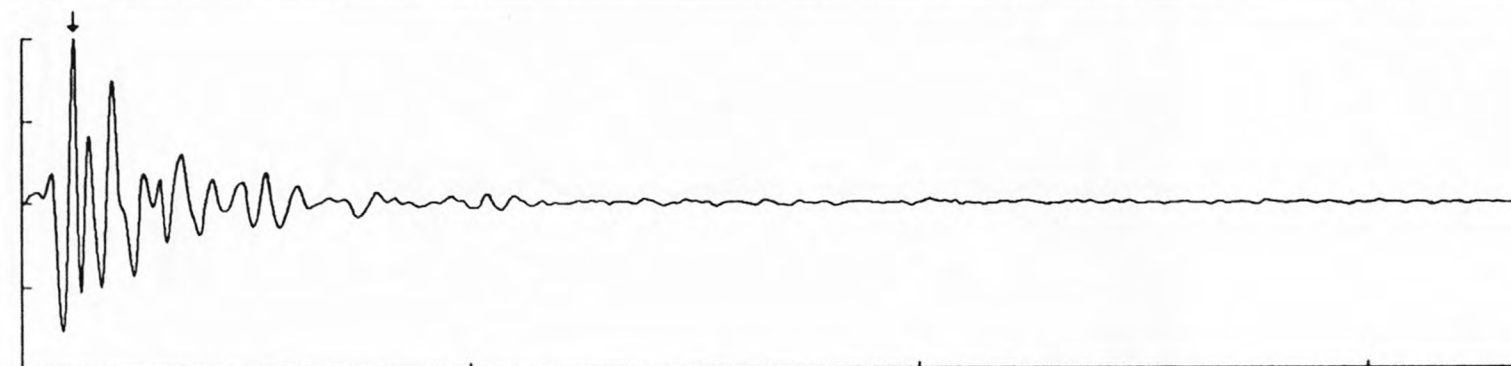
RAW DATA



INTERPOLATED/  
DECIMATED



FILTERED/  
WINDOWED



TIME - SECONDS

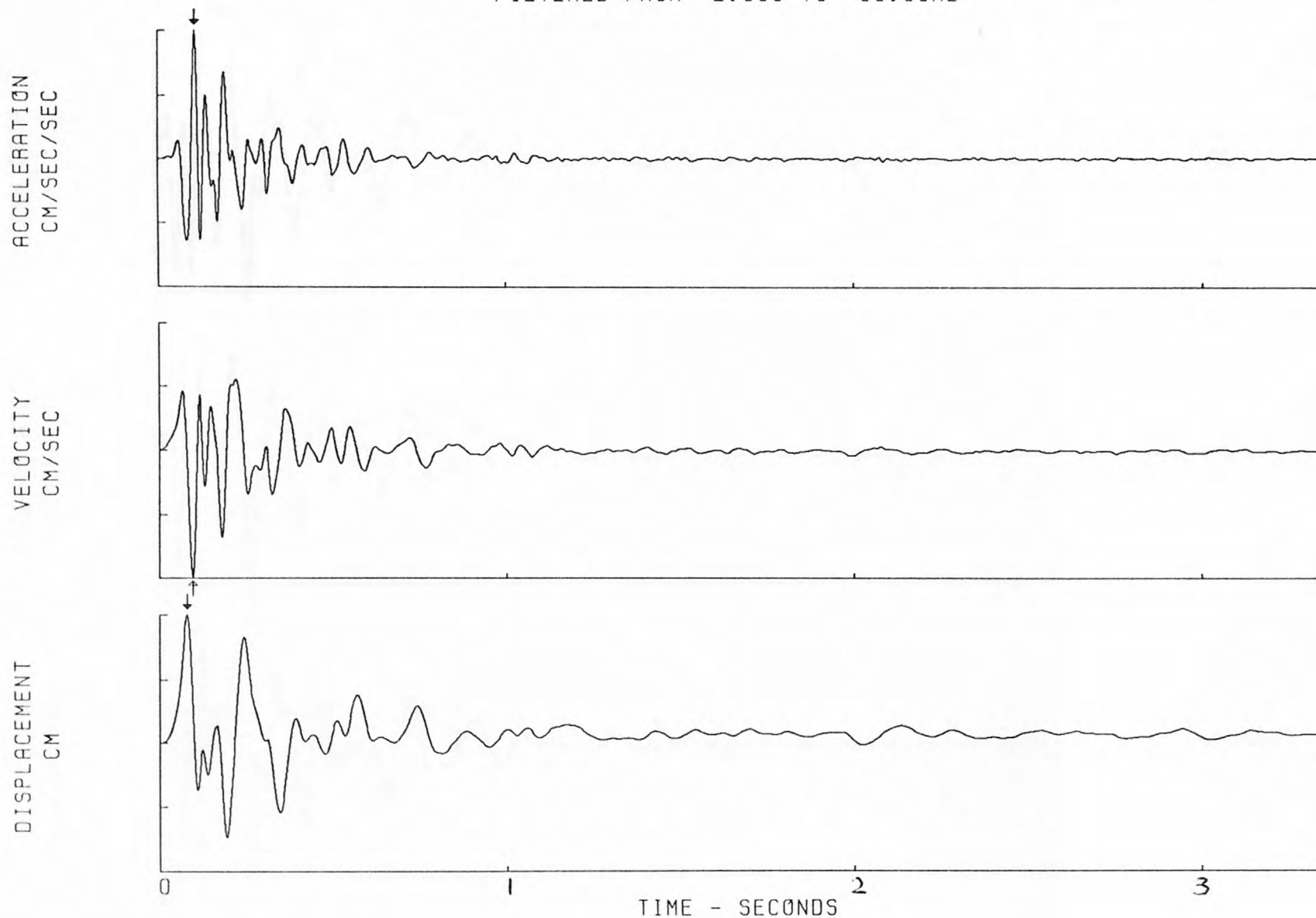


# 1ST AFTERSHOCK OF 27AUG78 - 1023 UTC EVENT

MONTICELLO CEN CREST, 8/01/78 AFTASHCK N01, 90 DEG

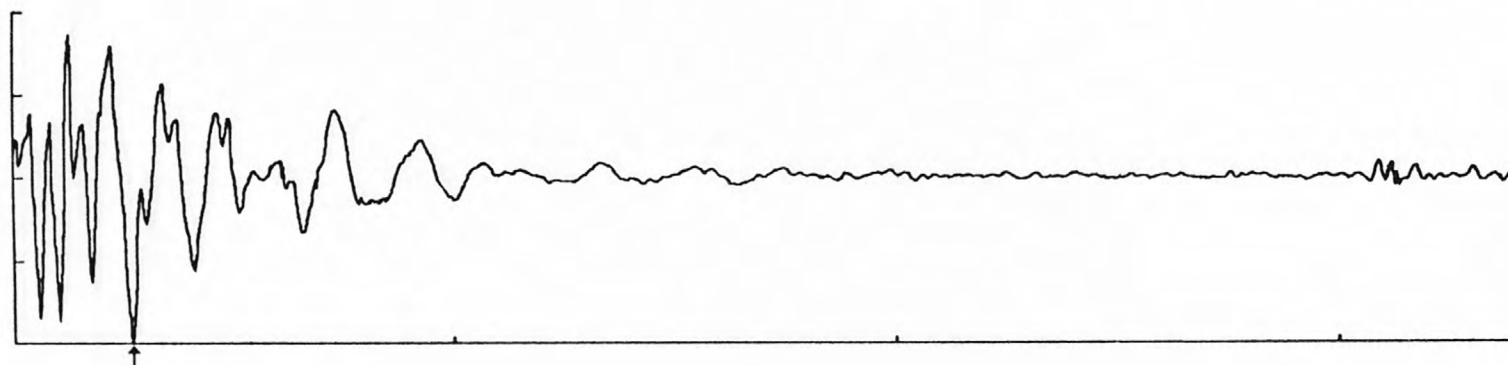
↑ PEAK VALUES: ACCEL= 178.8 CM/SEC/SEC, VELOCITY= -1.51 CM/SEC, DISPL= 0.019 CM

FILTERED FROM 2.000 TO 50.00HZ

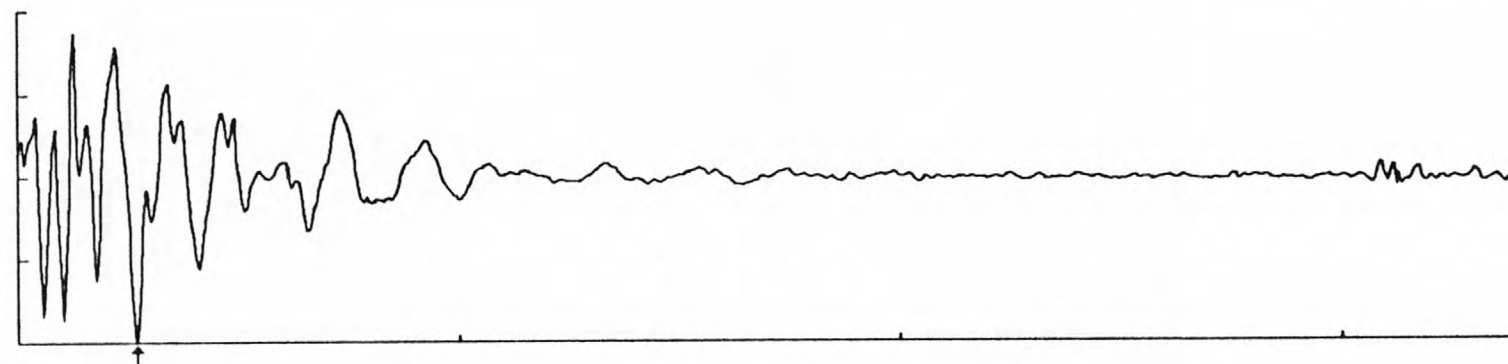


20ND AFTERSHOCK OF 27AUG78 - 1023 UTC EVENT  
MONTICELLO CEN CREST, 8/27/78 AFTSHCK N02, 180 DEG  
PEAK VALUES: RAW= -1.42 (G/10), INTERP= -140., FILTERED= -138. (CM/SEC/SEC)

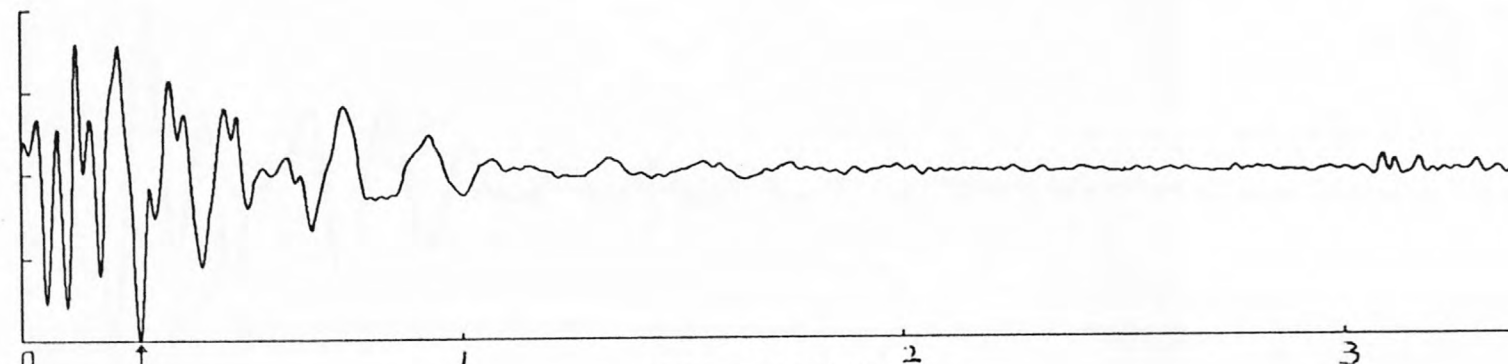
RAW DATA



INTERPOLATED/  
DECIMATED



FILTERED/  
WINDOWED



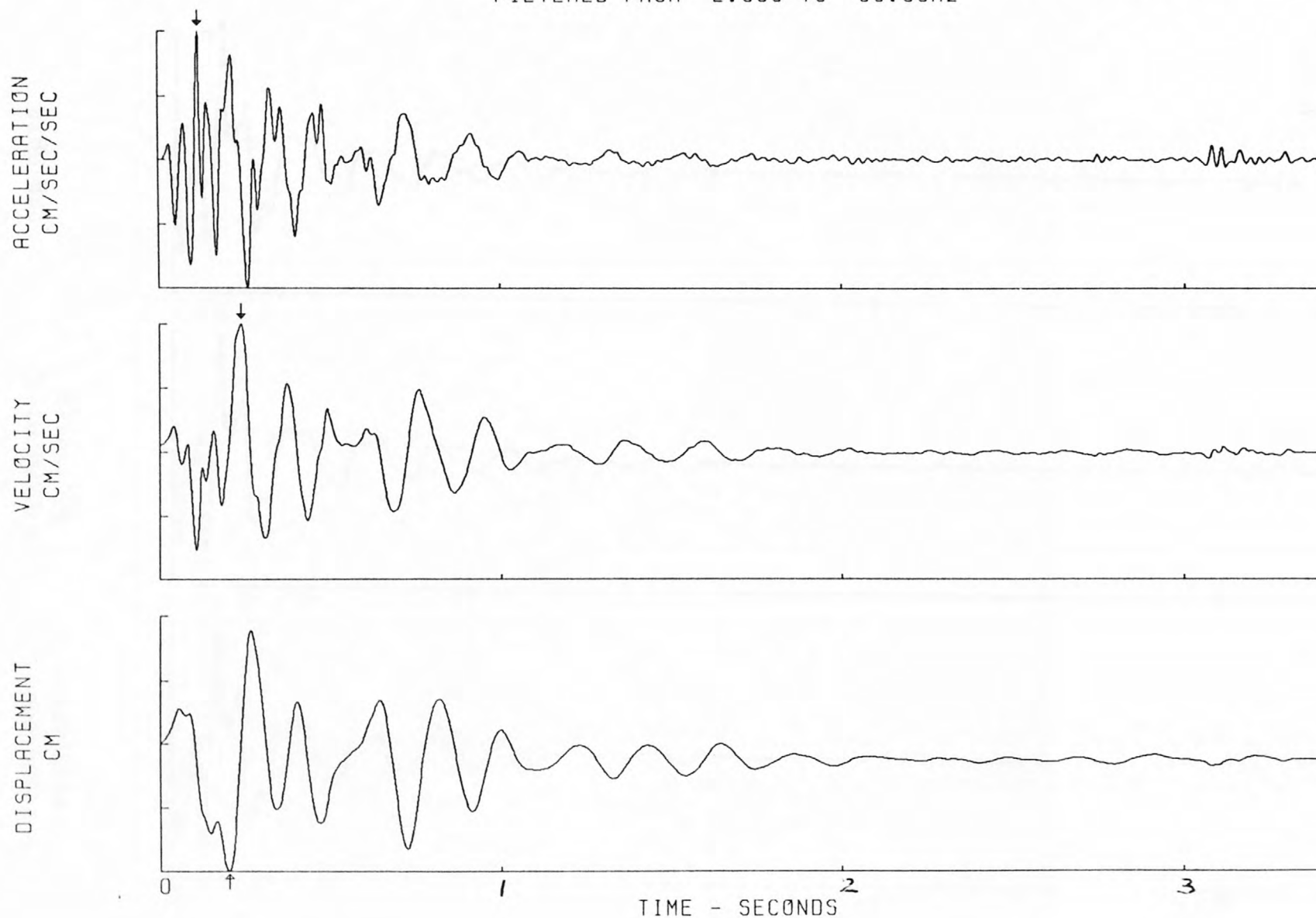
TIME - SECONDS

# 20ND AFTERSHOCK OF 27AUG78 - 1023 UTC EVENT

MONTICELLO CEN CREST, 8/27/78 AFTSHCK N02, 180 DEG

↑ PEAK VALUES: ACCEL= 139.3 CM/SEC/SEC, VELOCITY= 2.347 CM/SEC, DISPL= -0.05 CM

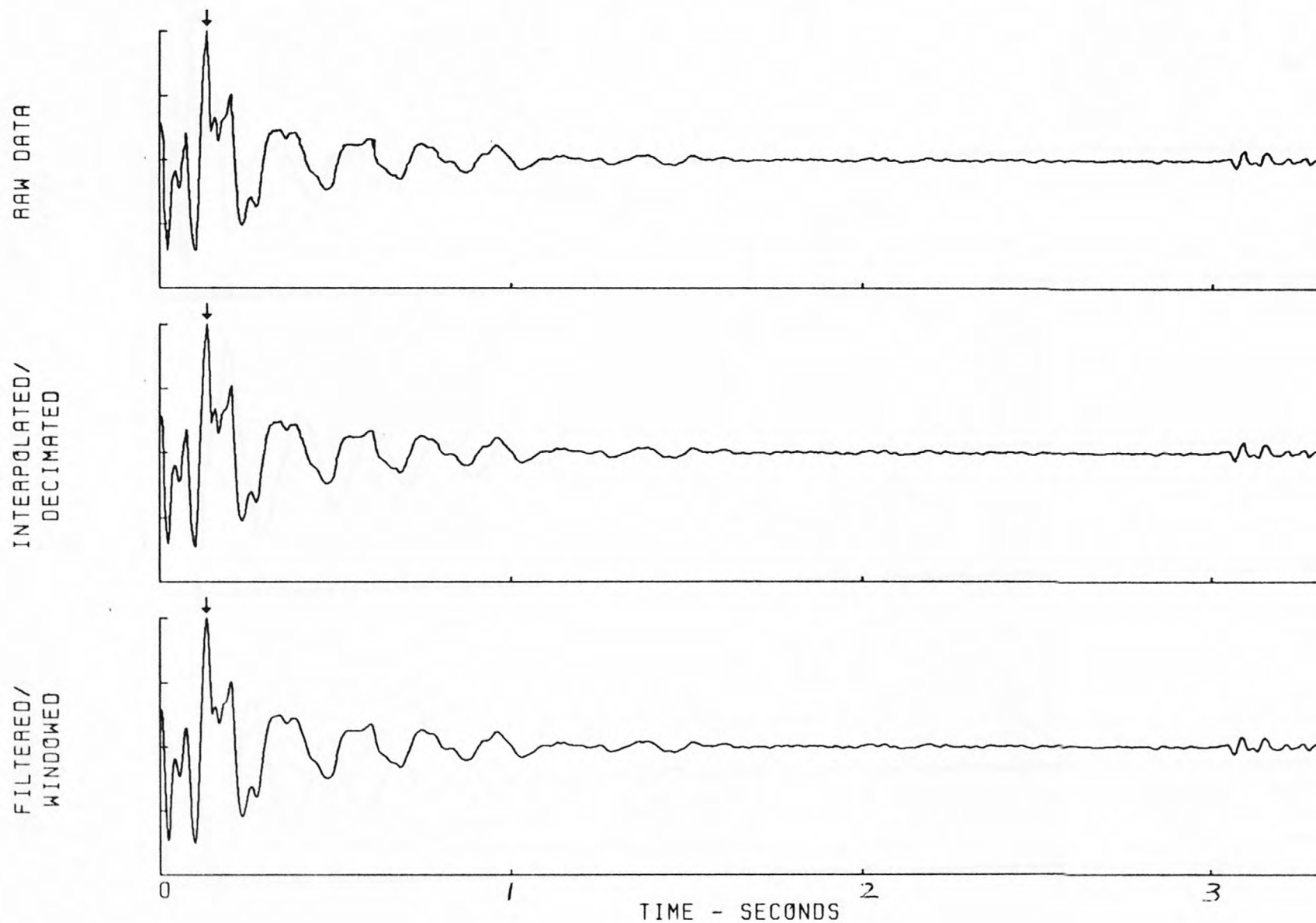
FILTERED FROM 2.000 TO 50.00HZ



# 20ND AFTERSHOCK OF 27AUG78 - 1023 UTC EVENT

MONTICELLO CEN CREST, 8/27/78 AFTASHCK N02, UP

PEAK VALUES: RAW= 1.871 (G/10), INTERP= 178.8, FILTERED= 173.0 (CM/SEC/SEC)

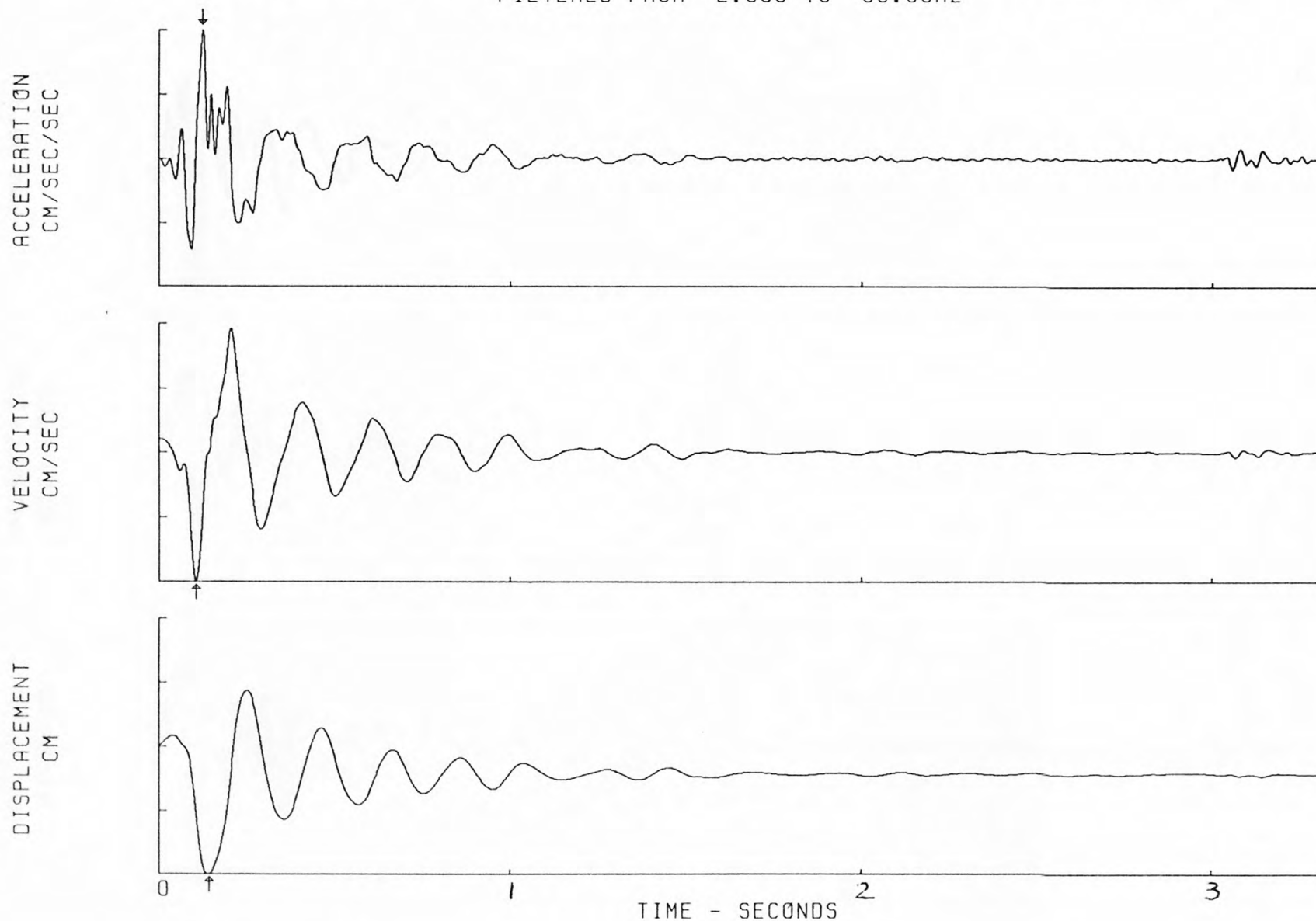


# 20ND AFTERSHOCK OF 27AUG78 - 1023 UTC EVENT

MONTICELLO CEN CREST, 8/27/78 AFTASHCK N02, UP

↑ PEAK VALUES: ACCEL= 174.6 CM/SEC/SEC, VELOCITY= -3.29 CM/SEC, DISPL= -0.12 CM

FILTERED FROM 2.000 TO 50.00HZ



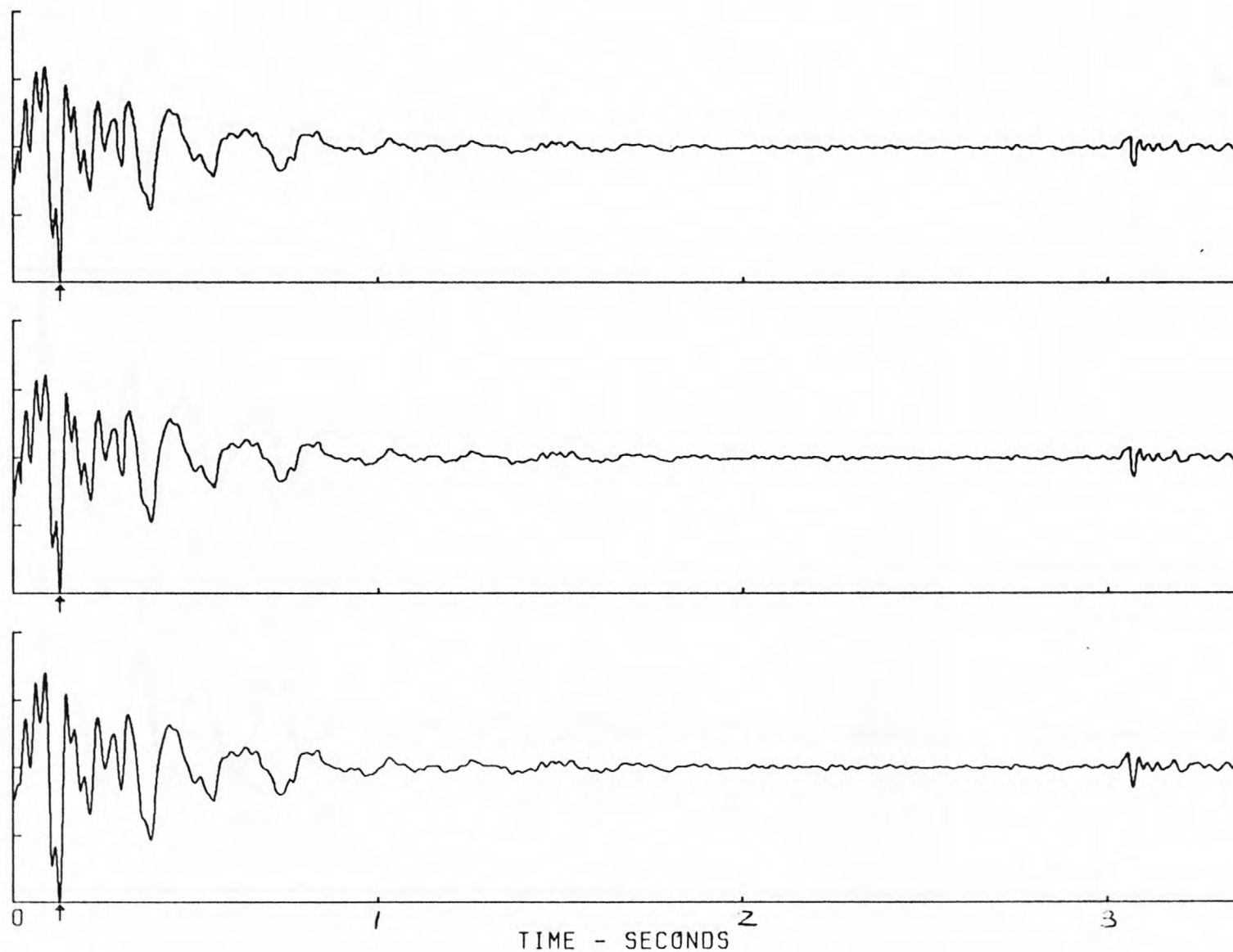


20ND AFTERSHOCK OF 27AUG78 - 1023 UTC EVENT  
 MONTICELLO CEN CREST, 8/27/78 AFTASHCK NO2, 90 DEG  
 PEAK VALUES: RAW= -2.36 (G/10), INTERP= -224., FILTERED= -200. (CM/SEC/SEC)

RAW DATA

INTERPOLATED/  
DECIMATED

FILTERED/  
WINDOWED

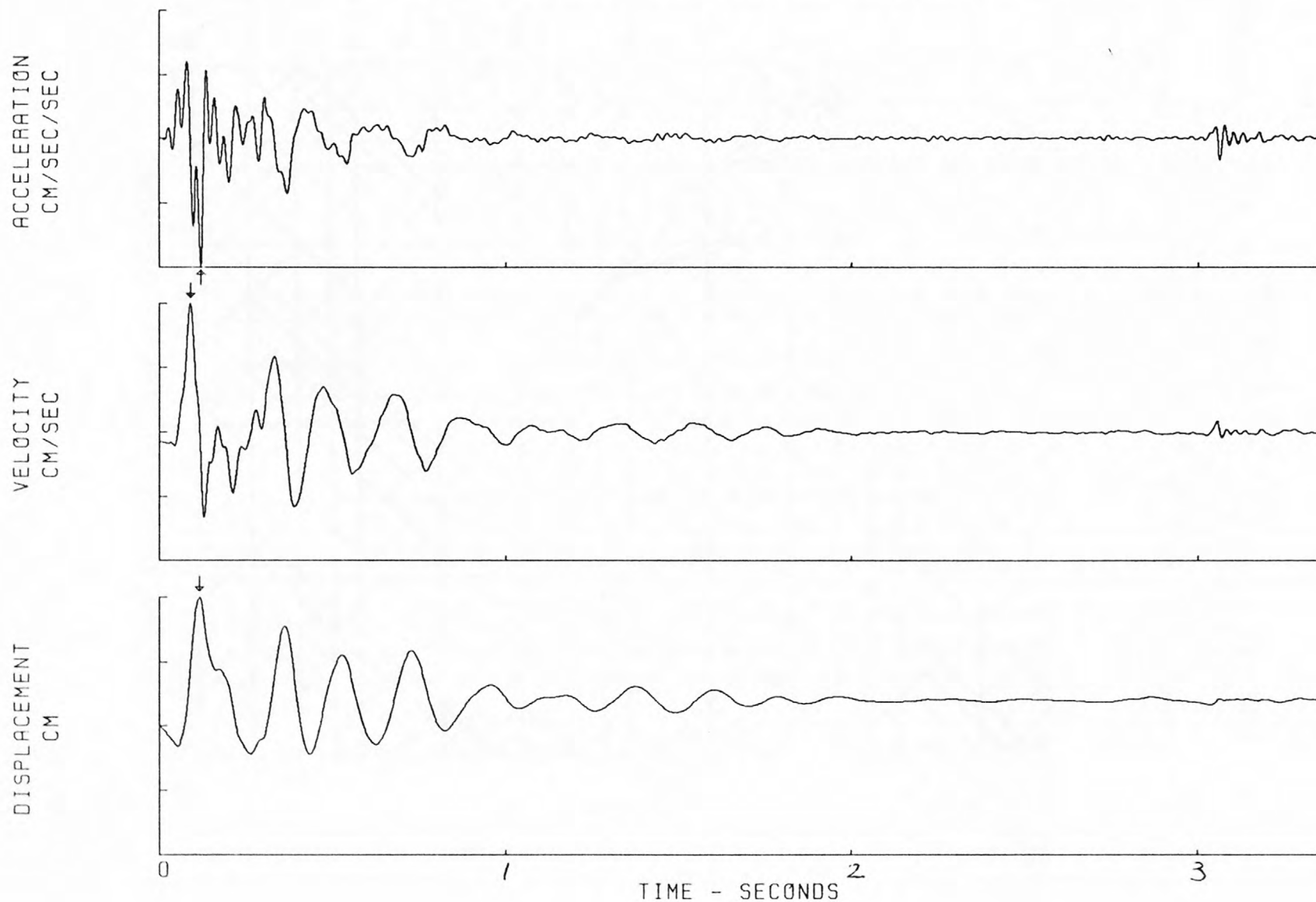


# 20ND AFTERSHOCK OF 27AUG78 - 1023 UTC EVENT

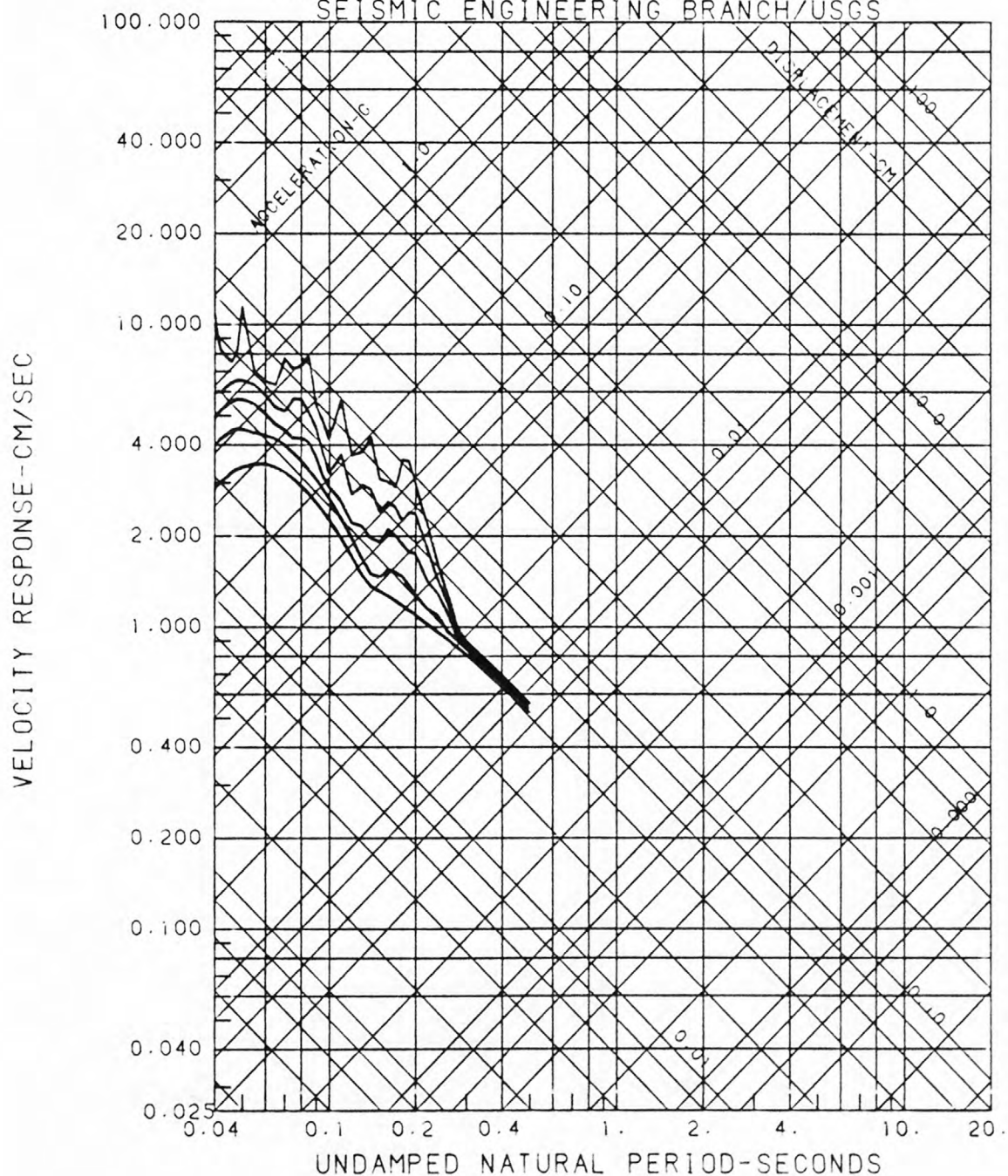
MONTICELLO CEN CREST, 8/27/78 AFTASHCK N02, 90 DEG

↑ PEAK VALUES: ACCEL= -269. CM/SEC/SEC, VELOCITY= 3.271 CM/SEC, DISPL= 0.086 CM

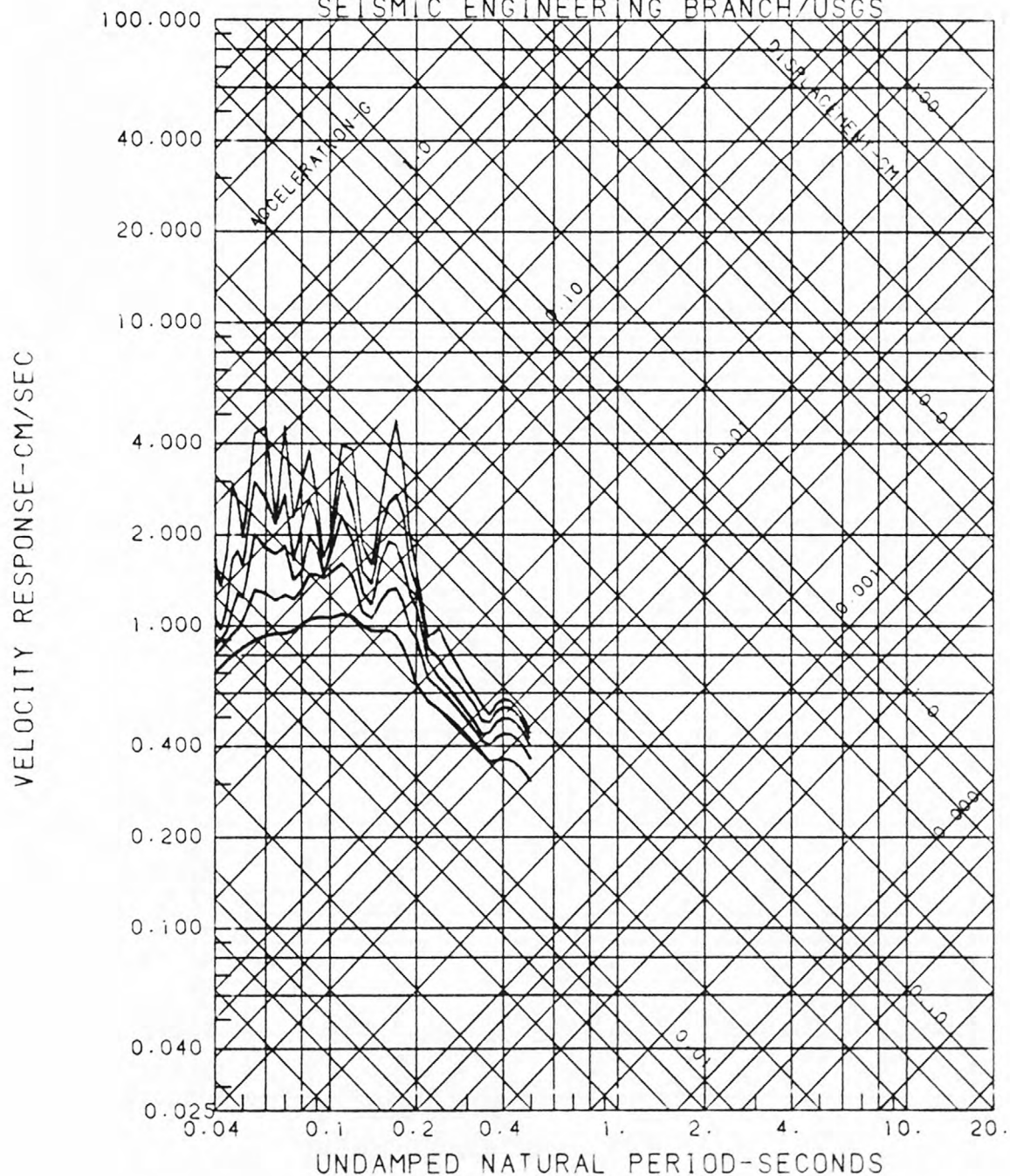
FILTERED FROM 2.000 TO 50.00HZ



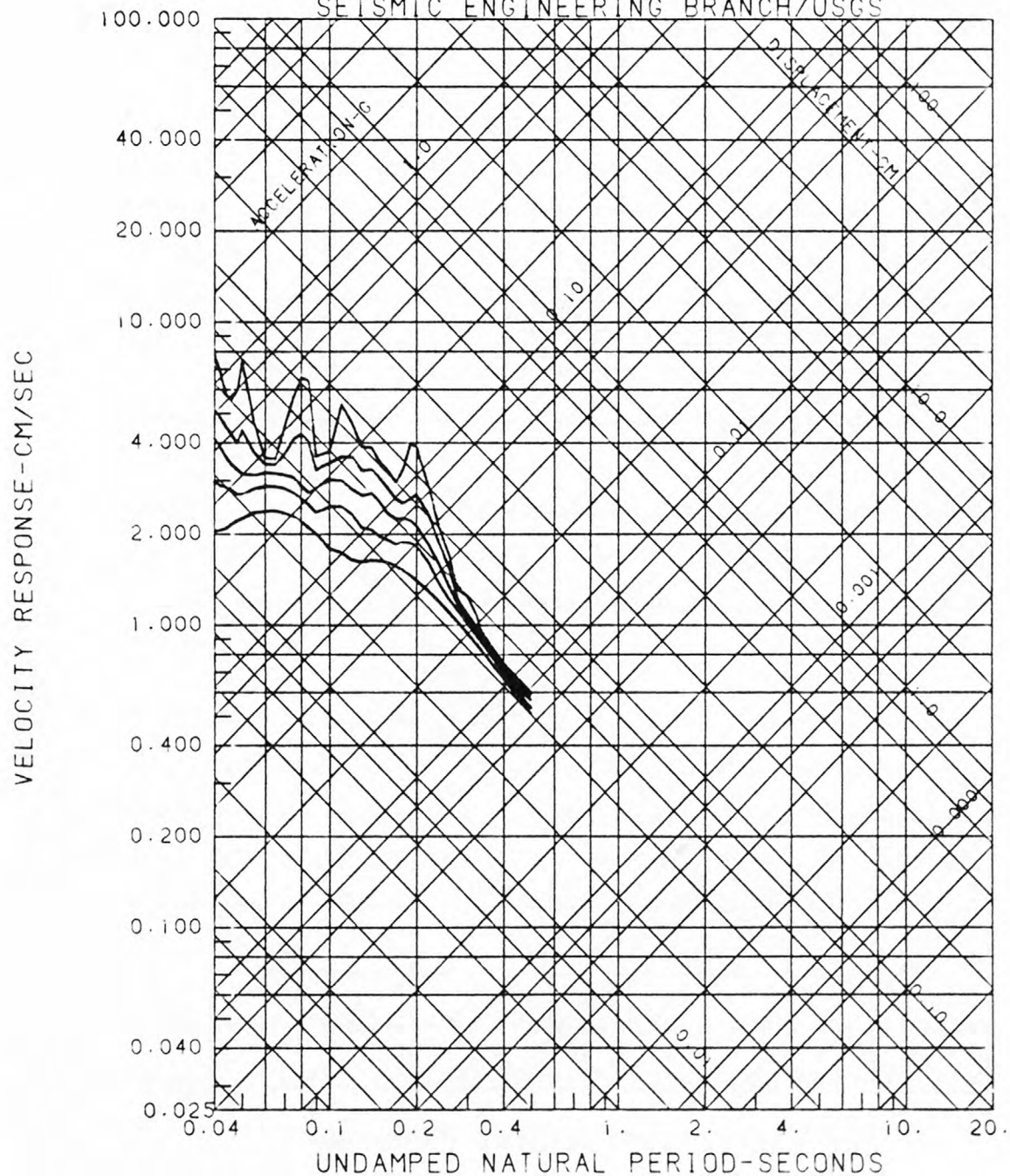
RESPONSE SPECTRA  
MONTICELLO CEN CREST, 8/27/78, 1023 UTC, 180 DEG  
0.2, 5, 10, 20 PERCENT CRITICAL DAMPING  
BAND PASSED FROM N=1. 2.000 HZ TO N=2. 50.00 HZ  
SEISMIC ENGINEERING BRANCH/USGS



RESPONSE SPECTRA  
MONTICELLO CEN CREST, 8/27/78, 1023 UTC, UP  
0.2, 5, 10, 20 PERCENT CRITICAL DAMPING  
BAND PASSED FROM N=1. 2.000 HZ TO N=2. 50.00 HZ  
SEISMIC ENGINEERING BRANCH/USGS

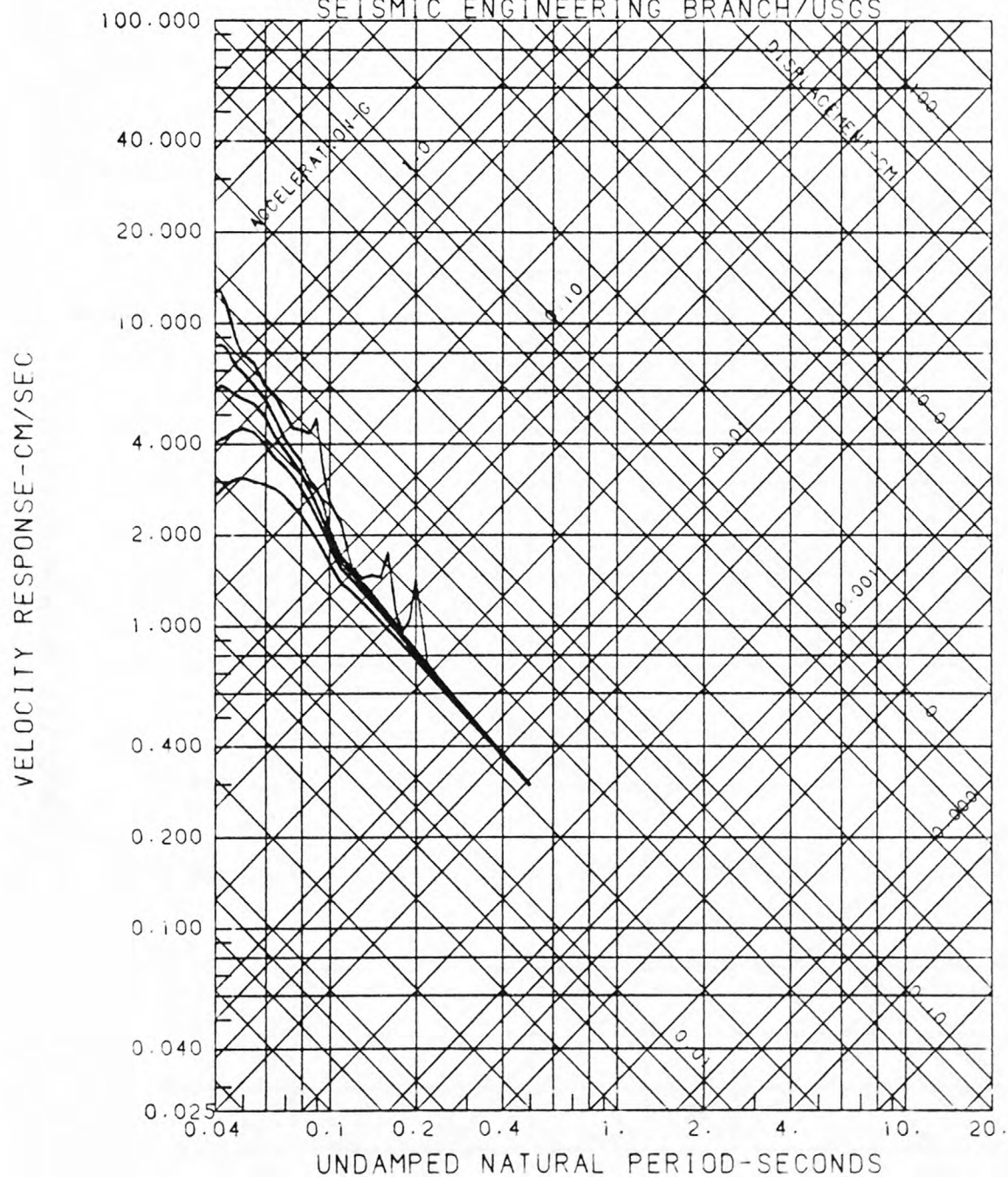


RESPONSE SPECTRA  
 MONTICELLO CEN CREST, 8/27/78, 1023 UTC, 90 DEG  
 0.2, 5, 10, 20 PERCENT CRITICAL DAMPING  
 BAND PASSED FROM N=1. 2.000 HZ TO N=2. 50.00 HZ  
 SEISMIC ENGINEERING BRANCH/USGS

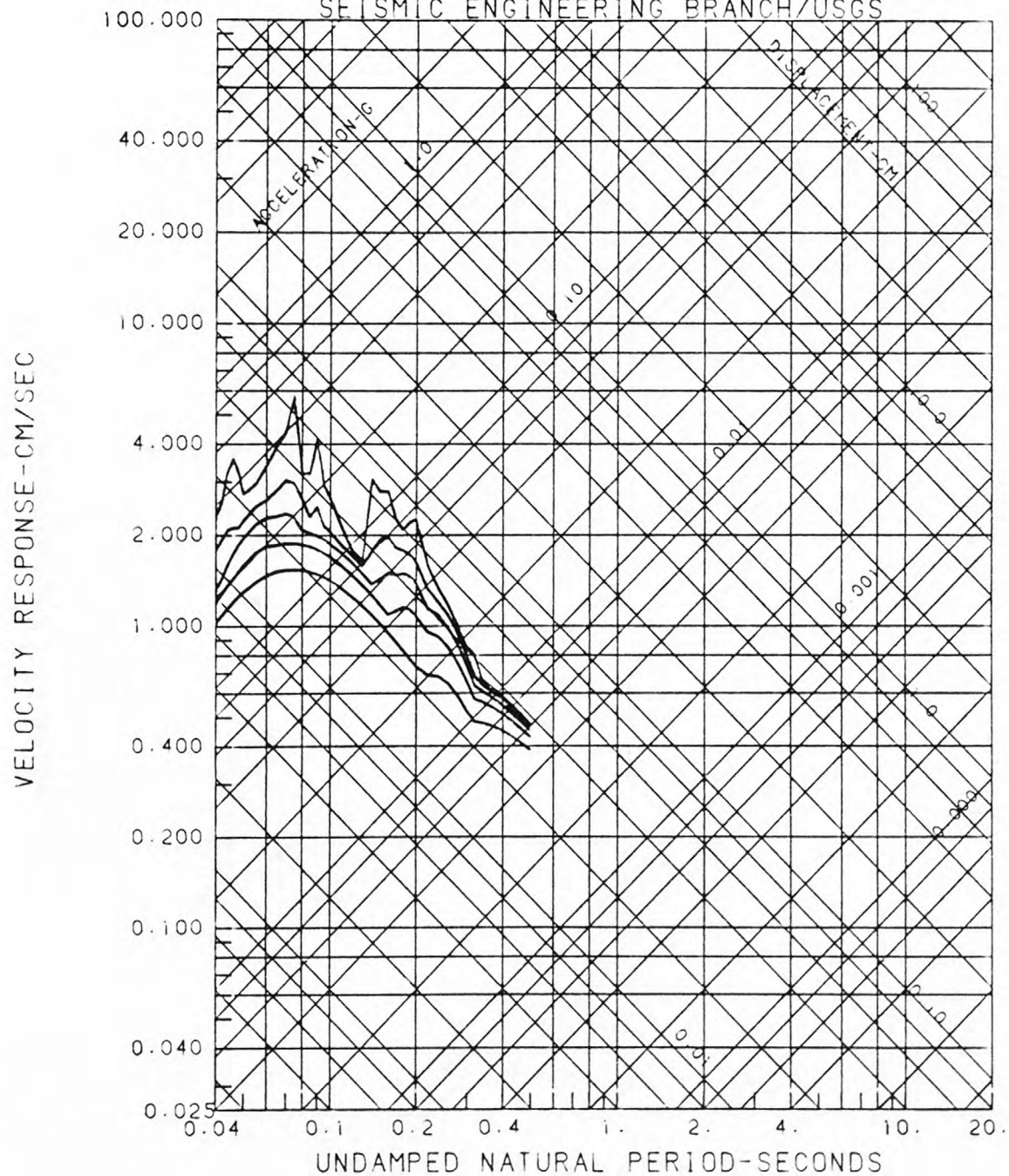




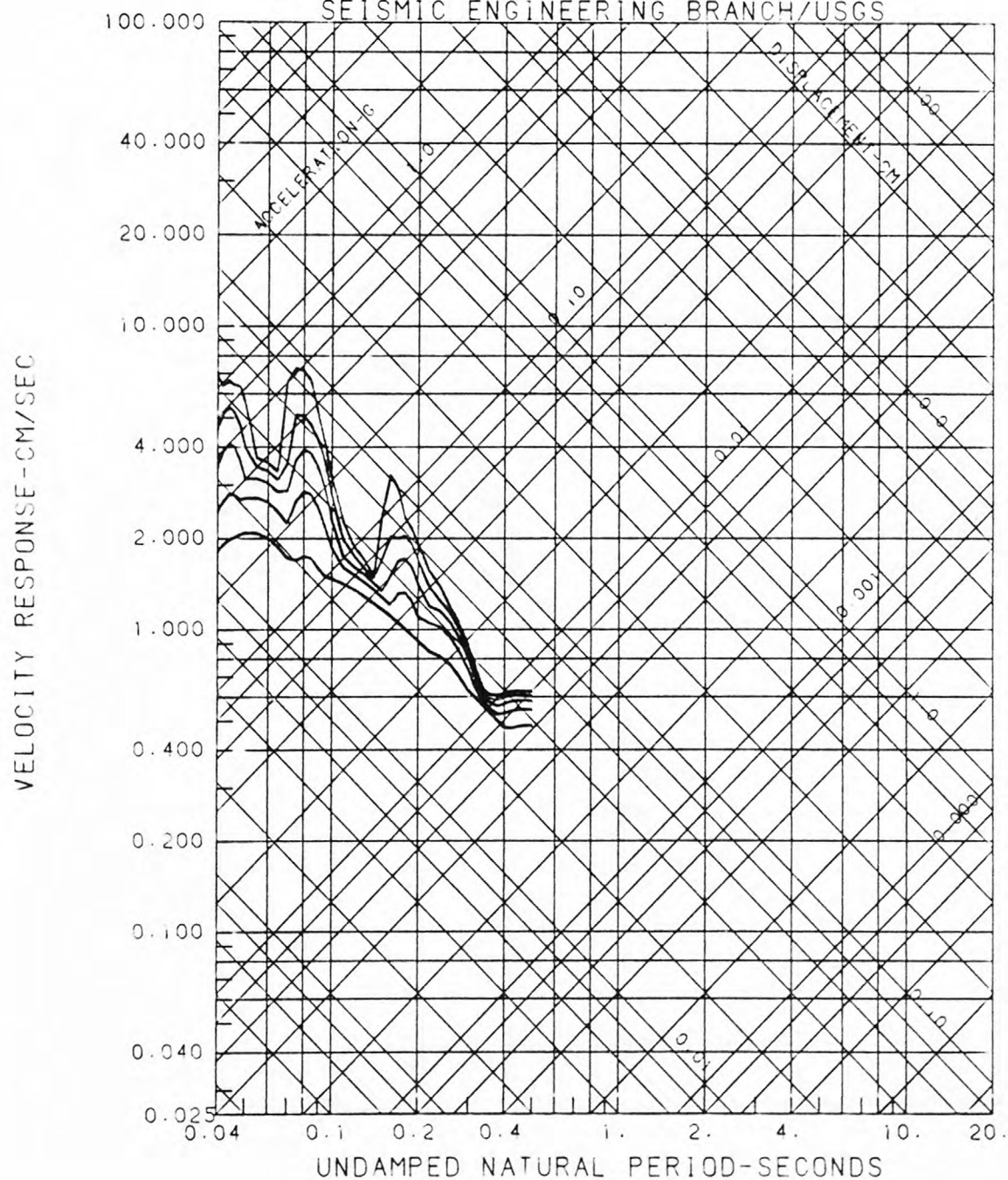
RESPONSE SPECTRA  
MONTICELLO CEN CREST, 8/01/78 AFTERSHOCK NO1, 180 DEG  
0.2, 5, 10, 20 PERCENT CRITICAL DAMPING  
BAND PASSED FROM N=1- 2.000 HZ TO N=2- 50.00 HZ  
SEISMIC ENGINEERING BRANCH/USGS



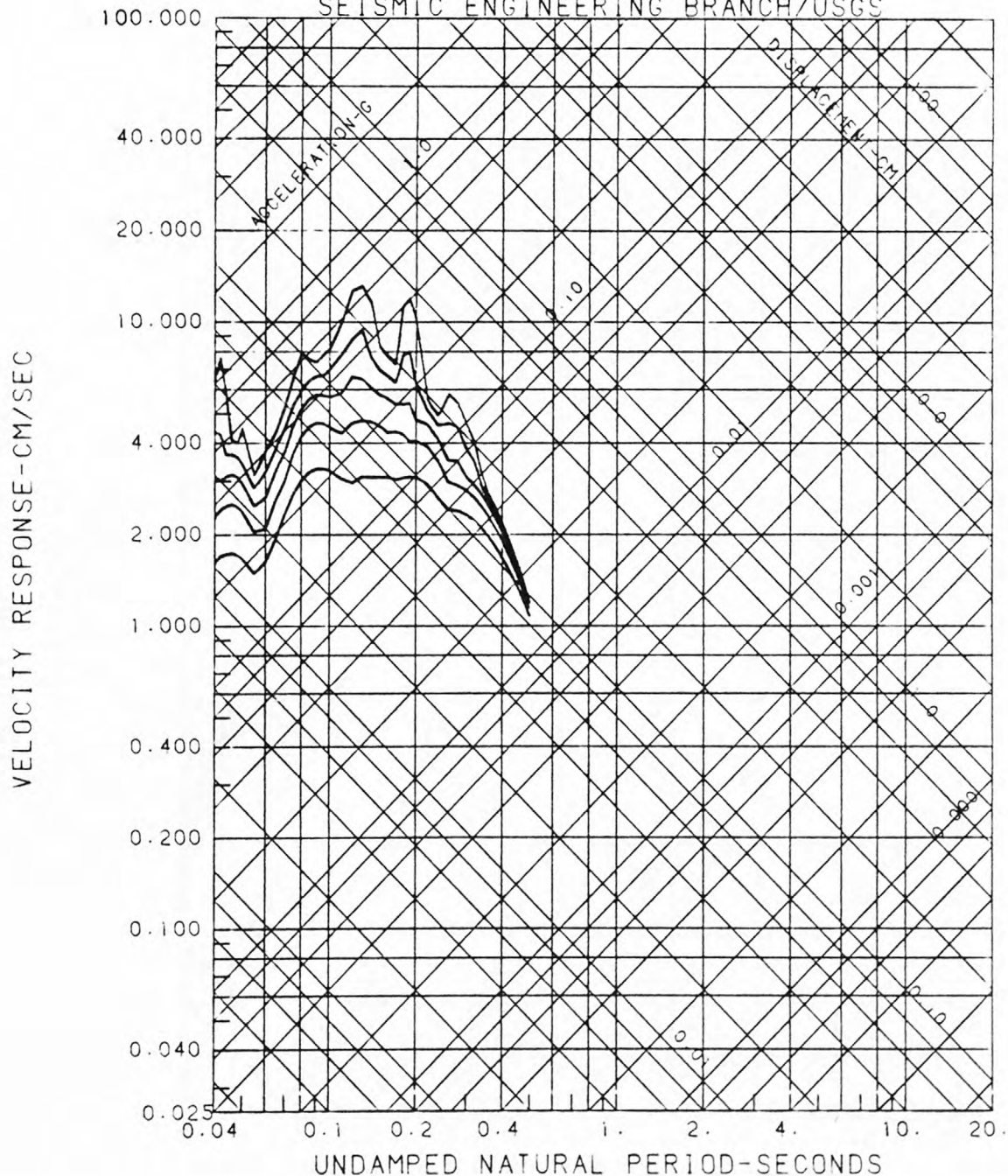
RESPONSE SPECTRA  
MONTICELLO CEN CREST, 8/01/78 AFTERSHOCK NO1, UP  
0.2, 5, 10, 20 PERCENT CRITICAL DAMPING  
BAND PASSED FROM N=1. 2.000 HZ TO N=2. 50.00 HZ  
SEISMIC ENGINEERING BRANCH/USGS



RESPONSE SPECTRA  
MONTICELLO CEN CREST 8/01/78 AFTERSHOCK NO1.90 DEG  
0.2,5,10,20 PERCENT CRITICAL DAMPING  
BAND PASSED FROM N=1- 2.000 HZ TO N=2- 50.00 HZ  
SEISMIC ENGINEERING BRANCH/USGS

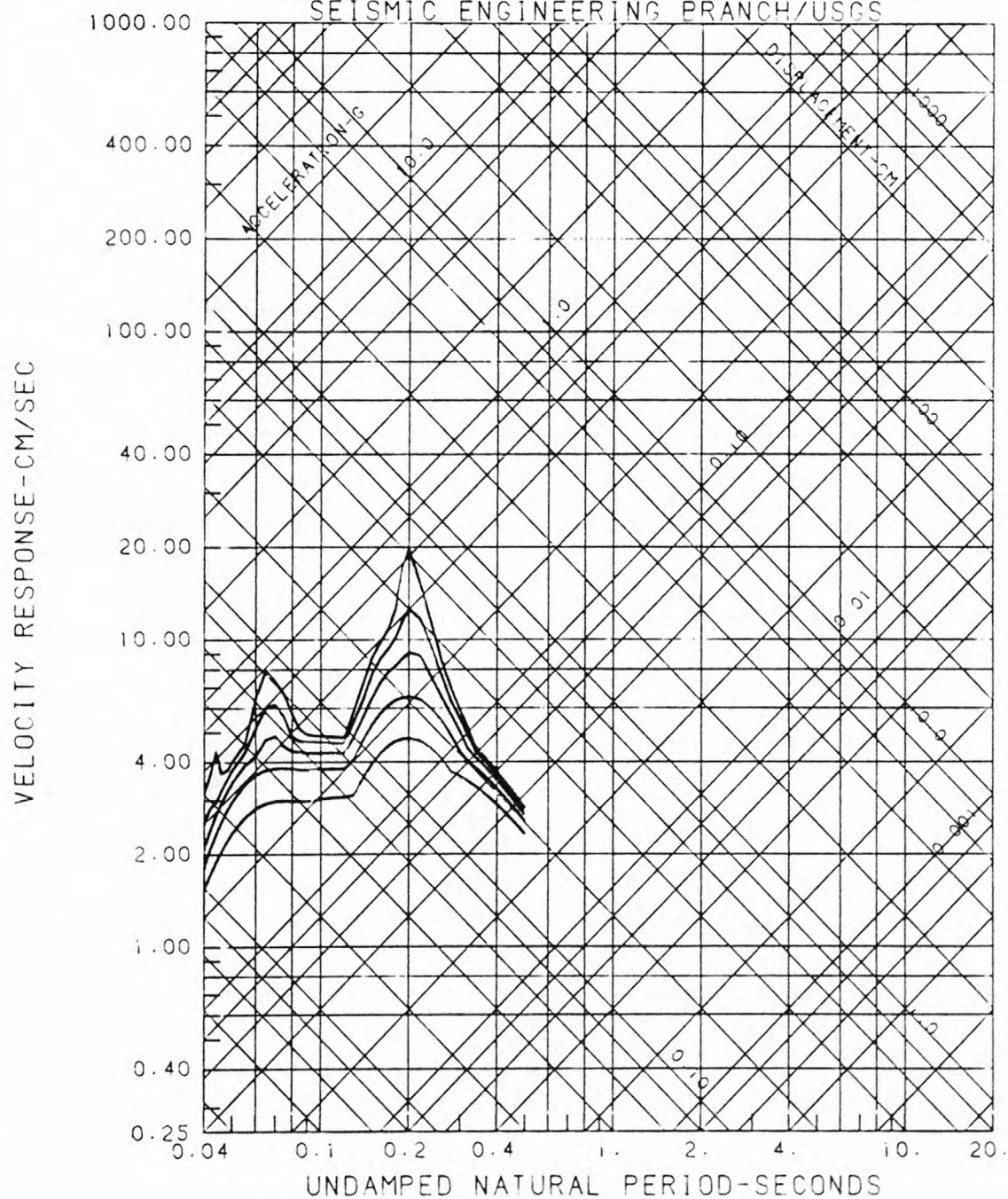


RESPONSE SPECTRA  
MONTICELLO CEN CREST. 8/27/78 AFTIRSHCK NO2. 180 DEG  
0.2, 5, 10, 20 PERCENT CRITICAL DAMPING  
BAND PASSED FROM N=1. 2.000 HZ TO N=2. 50.00 HZ  
SEISMIC ENGINEERING BRANCH/USGS



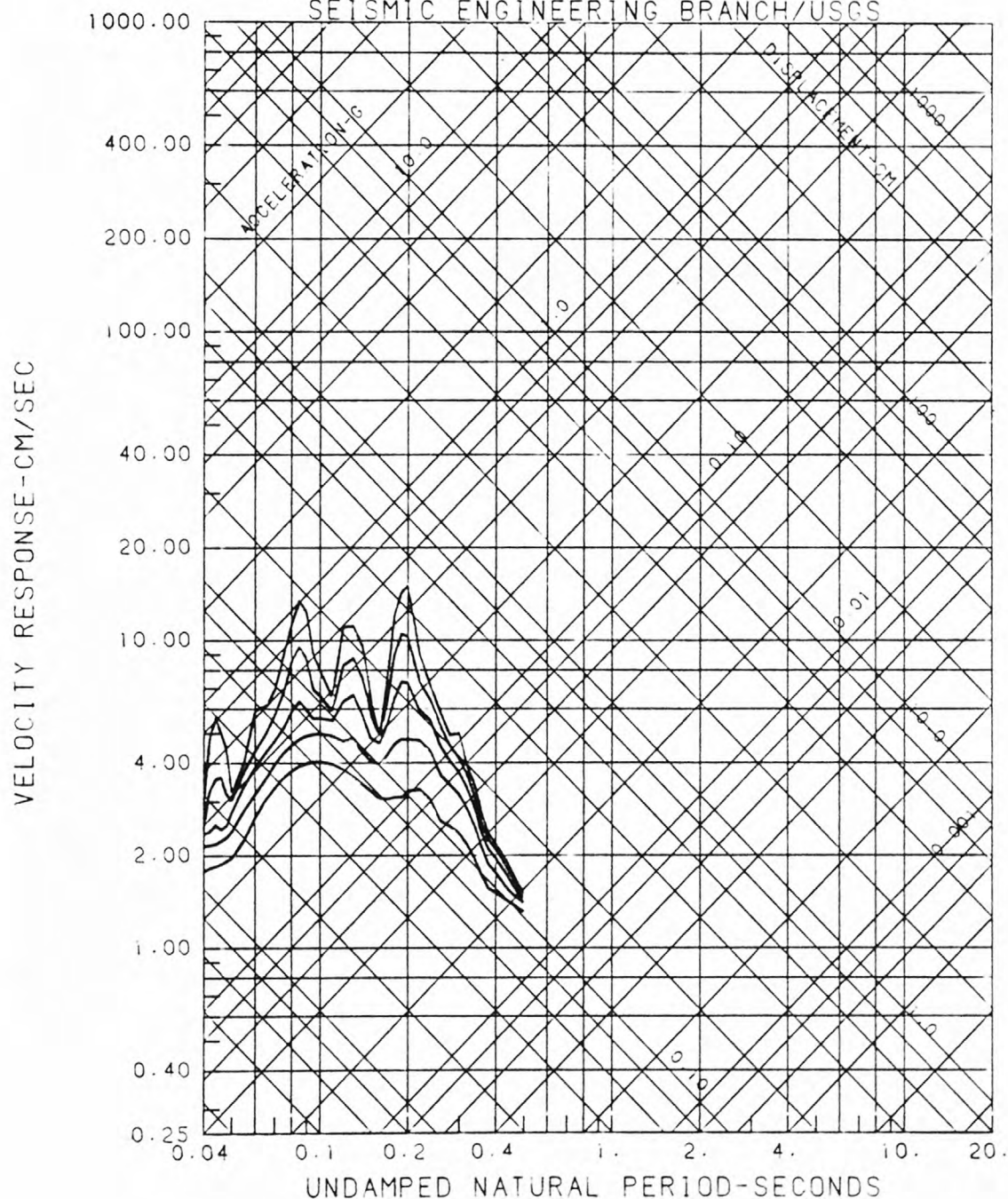


RESPONSE SPECTRA  
 MONTICELLO CEN CREST. 8/27/78 AFIRSHCK NO2. UP  
 0.2, 5, 10, 20 PERCENT CRITICAL DAMPING  
 BAND PASSED FROM N=1. 2.000 HZ TO N=2. 50.00 HZ  
 SEISMIC ENGINEERING BRANCH/USGS





RESPONSE SPECTRA  
MONTICELLO CEN CREST 8/27/78 AFTRSHCK NO2.90 DEG  
0.2, 5, 10, 20 PERCENT CRITICAL DAMPING  
BAND PASSED FROM N=1. 2.000 HZ TO N=2. 50.00 HZ  
SEISMIC ENGINEERING BRANCH/USGS





USGS LIBRARY-RESTON



3 1818 00070505 1