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CR-138864

S-193 IMPULSE RESPONSE CROSS CORRELATION

(Report Covering Sept. '73-March '74)

by

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WORK DONE UNDER

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Abstract / Summary

The impulse response of terrain to Altimeter (S 193)
Model I, periodic pulse train signal and its verification consists
of ground truth and terrain topographic data collection as well
as sky lab data procurement and computer analysis, and finally
the cross correlation between the sky lab data derived impulse
response and that obtained from the corresponding topographic
data.   The ground truth and topographic (elevation) data
were collected and reduced for Oregon Coast (SL #2) and Colorado
overpass (SL #3).   Seven track sky lab data was replaced by nine
track data by December, 1973 in order to save excessive computer
cost   Retrieval of data usable in this study was initiated
by late February 1974.   Computer programs for calculationg the
terrain impulse response from sky lab data were written, dry
run, rewritten and modified.   They are now considered operational.
The matter of frequency and time resolution in computer calculations
is still receiving more study.

A significant result for this period was the realization
that the phase information, normally lost in envelope detec-
tion and sampling, could have been preserved if the samples
were taken at the peaks of the carrier frequency at intervals
equal to a twice or an integral multiple of the integral number
of its period.   Thus the Skylab S 193 Model I altimeter data
does not contain phase information in accordance with the tech-
nical information obtained by us from NASA and Lockheed technical

personnel. Another significant discovery was to learn that the eight return pulse samples don't belong to the same pulse but represent an average over many pulses.

INTRODUCTION

The work for the period September, 1973 through March 31, 1974 is covered in this quarterly report, since the skylab data received until November 30, 1973 was not considered sufficient to yield any significant practical results. The reason was that skylab data received until November 30, 1973 was in seven track-magnetic tape format, and the reading of that data and reformating it to meet our Univac nine track requirement would have been excessively expensive and not possible within the budget provided. The request for nine track tape was processed by NASA-LBJ Space Center, and the first nine track data tape on S 193 Altimeter Mode 1 was received in late December, 1973. (Future reports shall be submitted quarterly.) Then it was possible to dry run our computer programs on that data to verify basic needs as to resolution in time and frequency domain for the terrain impulse response calculation from this data. Various aspects of our work under this contract with their present status are listed below under separate subtitles.

1. SKYLAB-ALTIMETER DATA

(A) S 193 Altimeter Mode 1: Since the start of and receipt of the nine track magnetic tape Altimeter (S 193) Mode 1 data in December, the following data tapes have been received:

1. SL-2 Project No. 8552C   Nasa tape # 906153 (s19313-101-2-1-
   73-3)
   Covering Oregon Coast   Time: 150-20-35-41

   Thru: 150-20-46-45

2. SL-3 Project No. 8550   Nasa tape # (s-93-100-01-12-72A)
    Covering Colorado   Time: 215-17-54-13 907259

                             Thru: 215-18-16-29

3. SL-2 Project No.   Nasa tape # 906154/5

    Covering the Gulf Coast and Montana Time: 160-15-03-30

                                                 160-15-07-14

                                                 160-15-11-35

                                                 160-15-18-4

4. SL-3 Project No. 8550 Nasa tape # S193-13-099-01-42-73-B

    Covering Mexico and western part of Texas

                                    Time: 258-16-23-06

                                            258-16-45-05

                                            258-16-23-9

                                            258-16-18-4

Since we are unable to associate tape numbers three and four
above with preplanned flight and sites for Altimeter Mode 1
overflight, although efforts to salvage usable information
from tapes is continuing to be made. Data from Tapes numbers
one and two was taken over the sites assigned namely # 851167
and # 398295 respectively, and hence his data is being analyzed.

(B) S·191 and 190 and Associated Data

Other associated data including transparencies of color film
shots covering two sites have been received for SL-3 corresponding
to dat tape numbers two and four above since January 1974.
An exact coordinate match is underway forvisual verification
of data.

(C) General and Specific Information

The product S073-5 for S193 Mode I has been requested for sites

covered for this study, since only eight point pulse data is

available, and the resolution enhancement is a major concern

as discussed below.

Ground Truth Data

The ground truth data consists of such factors as moisture,

rain fall, foliage, season, man-nade effects such as timber

cutting, mining or farming, forest fires etc,, type of forestation,

crops or grass etc., and topographical data. The status of this

work to date of the Oregon and Colorado sites is as follows:

1. Site visit completed

2. Photographic and visual information on landscape,

   foliage, crops, or forestation, man-made effects collected

3. Topographic maps have been read, and data collected

4. Ground track of skylab has been delineated in order

   to pinpoint any special features along it

The S-193 Altimeter Mode I data over the Texas Hats Site

apparently was not taken during all skylab passes, and therefore

the ground truth along the overpass over the planned Hats site has

not been compiled, although topographic maps for this planned

overpass were procurred.

Topographic Data and Analysis

The resolution of topographic data is 80 feet for all quad-
rangles in the Colorado overpass except for the quadrangles of
Nucula, Silverton, Wolf Creek, Chama Peak, and Brazos Peak; for
which the 208 feet resolution data will be interpolated to yield
points 80 feet apart, resulting in expanding these sectional data
points by a factor of approximately 2.5 . Similarly, the resolution
for the topographical data for the Oregon overpass data is 208
feet.

This data is ready for correlation analysis using a moving
window, which is equivalent to a period of the S-193 pulse, so
that the pathlength on the ground illuminated by the altimeter pulse
could be the same as the width of the window in our data processing.
The only delay in initiating this processing is the receipt of de-
tailed information on the S-193 transmitted pulse shape, since the
point of return form the ground shall depend on cT/2 where c is the
velocity of light or 3 x 10^8 meters/sec and T is the effective pulse
width, which is approximately 72 to 100 nanoseconds.

Furthermore, it has just come to our attention that in S-193
pulse shape experiment Mode I, the eight samples are so taken that
these:

a. do not belong to one return pulse

b. are not consecutive in information sense, except in some
   "average" sense.

c. can not be said to represent a single foot print of S-193
   beam on the ground

The Skylab Altimeter S-193 Mode I pulse data was taken using a pulse train with a nominal pulse width of 100 nanoseconds and a repetition rate of 250 pulses per second. Furthermore, the return pulse was sampled eight times during each pulse duration, and the sample spacing was 25 nanoseconds. This would yield a spatial sampling rate,for the terrain under the skylab,of a sample every 84,5 feet. since the skylab ground speed is approximately 4 miles per second or 21 feet per millisecond. Therefore the pulse period is the equivalent of 4 x 21 = 84 feet on the ground.

An exact detail of sampling method or routine has been requested from NASA for a clear understanding of which ground samples, the average received pulse represents.

Transmitted and Received Pulse

In Mode I pulse shape S-193 Altimeter experiment, due to no detailed information on the shape of the transmitted pulse x(t), it was assumed that it was an ideally square pulse of 13.98 ghz carrier. Later on inquiries on the rise and decay time of this pulse led us to find out that the pulse shape is indeed not spuare , but somewhat gaussian; but again the details of the clipped gaussian pulse are not, to this date, available from either NASA or NASA Contractors, such as Lockheed Electronics and Research Triangle Inc. in North Carolina; although these are expected to be received before the next quarterly report is issued.

The importance of the shape of this transmitted pulse is demonstrated by the Fourier Transforms given below:

Case I: Rectangular Pulse.

If the envelope of the transmitted pulse x(t) has a period T and pulse width a, then its Fourier Transform pair would be given below:

$$x(t) = \begin{cases} 1 & -a/2 \le t \le a/2 \\ 0 & \text{OTHERWISE} \end{cases} \quad \text{OVER} \quad -T/2 < t < T/2$$

$$= \sum_{n=-\infty}^{\infty} C_n \exp \cdot j\omega_n t$$

$$C_n = (1/T) \int_{-a/2}^{a/2} x(t) \exp(-j\omega_n t)\,dt = (a/T)\frac{\sin(\omega_n a/2)}{(\omega_n a/2)}$$

where $w_n = n w_0 = 2\pi n/T$

Futher more the power spectral density $P_x(f)$ would be given as:

$$P_x(f) = |X(f)|^2 = \sum_{n=\infty}^{\infty} |C_n|^2\, \delta(\omega - \omega_n)$$

with phase angle spectrum

$$\phi_x(f) = \tan^{-1}\left(\text{Imaginary Part of } C_n \,/\, \text{Real part of } C_n\right) = 0$$

Case II: Gaussian [approximated by (sin x/x) form]

If the envelope of the transmitted pulse x(t) is approximated by an gaussian curve, as understood by telephonic inquiry as of April 1, 1974, then its Fourier transform pair shall be given as:

$$x(t) = A\left(\sin bt \,/\, bt\right) \qquad \text{for } -\infty < t < \infty$$

$$X(f) = \int_{-\infty}^{\infty} x(t)\, e^{-j\omega t}\, dt$$

$$= 2\int_{0}^{\infty} A\,\frac{\sin bt}{bt} \cdot \cos \omega t\, dt$$

$$= \begin{cases} \pi/b & |\omega_n| < b \\ \pi/2b & \omega_n = b \\ 0 & |\omega_n| > b \end{cases}$$

Since the following integral holds:

$$\int_{-\infty}^{\infty} (\sin at \; \cos xt)/t \; dt = \begin{bmatrix} \pi & |x| < a \\ \pi/2 & x = a \\ 0 & |x| > a \end{bmatrix}$$

Note again that the phase spectrum is zero here as well.

Case III: Truncated Gaussian Pulse

The real case of S-193 Mode I pulse is closest to a truncated gaussian pulse. For instance, let us say over, one period, one may write $x(t) = A \exp(-K^2 t^2)$ $-T/2 < t < T/2$ and its generalized fourier coefficient C_n shall be defined as:

$$X(t) = \sum_{n=-\infty}^{\infty} C_n \exp. j\omega_n t$$

and

$$C_n = (1/T) \int_{-T/2}^{T/2} \exp.(-k^2 t^2 - j\omega_n t) \; dt$$

Let $Kt = t_1$ and therefore $kdt = dt_1$ and hence

$$C_n = (2/Tk) \int_{0}^{kT/2} \exp.(-t_1^2) \cos(\omega_n/k \; t_1) \; dt_1$$

$$= (2/Tk)(\sqrt{\pi}/4x \; e^{\omega_n^2/2k}) \left[erf(x - j\omega_n/2k) + erf(x + j\omega_n/2k) \right]_{x=0}^{x=kT/2}$$

Since $\int \exp(-x^2) \exp. ax \; dx =$

$$= \left[\sqrt{\pi}/4 \; \exp(a^2/4) \right] \left[erf(x - ja/2) + erf(x + ja/2) \right]$$

where $erf(x) = (2/\sqrt{\pi}) \int_{0}^{x} \exp(-t^2) \; dt$

[Ref. 313.6   p.109   GROSSNER & Hofreiter]

Upon substitution of limits in the value of C_n, one obtains:

$$C_n = (2/Tk)(\Pi/16)^{1/2}\exp(\omega n/2k)^2[\text{erf}(kT/2-j\omega n/2k)+\text{erf}(kT/2+j\omega n/2k)$$

$$-2\text{erf}(j\omega n/2k)]$$

since $\text{erf}(-x) = \text{erf}(+x)$

It is important to note that the power spectral density of $x(t)$ is $|C_n|^2$, and its phase spectrum is not the same as in cases I and II.

Case IV: Truncated Gaussian Pulse with Fast Drop Off.

In this case the Fourier Transform integral for C_n in the previous case may be modified to extend its upper and lower limits to infinity since the pulse is already assumed to have dropped to negligible and essentially zero amplitude before reaching the limits of its period. Thus we would obtain:

$$C_n \approx x(f)_n = (2/T)\int exp(-k^2t^2)\cos w\, t\, dt$$

$$= (2/T)(\Pi/4k^2)^{1/2}\exp(-w^2/4k^2)$$

Note that in this approximation the power spectral density of $x(+)$ in a given period is essentially the same as that obtained in Case III but its phase spectrum is zero as was the case in Case I and Case II.

Importance of Power Spectrum and Phase Angle Spectrum in Impulse Response Calculations.

The results obtained above will now be shown to have significance in this study, where the power and phase spectrum of $x(t)$ is needed to calculate the impulse response of the terrain radiated by S-193 pulse. Let the received pulse be $y(+)$, and its

power spectral density $P_y(w)$, the phase angle spectrum $P_y(w)$, and the corresponding values for $x(t)$ as $P_x(w)$ and $\phi_x(w)$. Then the Fourier Transform of $h(t)$, the terrain impulse response is given by the following relationships:

$$Y(j\omega) = X(j\omega)\, H(j\omega)$$
$$P_y(\omega) = P_x(\omega)\, P_h(\omega)$$
$$\phi_y(\omega) = \phi_x(\omega) + \phi_h(\omega)$$

and therefore

$$h(t) = \frac{1}{2\pi} \int_{-\infty}^{\infty} P_h^{1/2}(\omega)\, exp.\, j\, \phi_h(\omega)\, d\omega = INV.\ F.F.T \left[(P_y/P_x)^{1/2} exp.\, j\, (\phi_y - \phi_x) \right]$$

In this connection the Fast Fourier Transform technique was used to solve for h(t) given the eight sampled values of $x(t)$. A typical program for this effort is attached and it is the result of extensive computer analysis of data samples of the type available from S-193, with basic intent to enhance resolution of the $h(t)$.

Most early programs yielded a quick drop-off of the values of $h(t)$ for t greater than zero. In fact the first value, for the data shown on attached pages A1-A6, would be 176.51 and the next would be 0.539. A special technique of padding data with optimum number of zeros has now yielded at least 4 to 8 point resolution. In this effort eight S-193 return pulse sample values are extended to 256 points by adding 248 zeros at the end, and assuming that the phase angle information for the eight points is unknown and assumed zero as is the case of envelope detection.

Other programs with phase angle imput, with eight points of $x(t)$ were also tried and the results were significantly interesting. A close analysis of this part of the work reveals that this system would have been much more effective for such work and all other

surface effects if the pulse samples were taken at the peaks of the carrier signal and synchronized to the starting of the pulse at its positive zero crossing, and thus preserving its phase information.

Conclusion:

Recommendation for a new simple technique has been advanced to enhance the capability of S-193 Mode I altimeter pulse shape experiment. Futher work on the transmitted pulse shape specification and its effect on the impulse response of terrain shall be reported in the next quarterly. Futhermore cross correlation between different skylab data and the impulse response calculated shall be reported in the next report.

```
@FOR.US      SKYLAB.MAIN,.MAIN
FOR S011-04/04/74-13:47:34 (2,3)

  MAIN PROGRAM

  STORAGE USED: CODE(1) 000277; DATA(0) 010103; BLANK COMMON(2) 000000


  EXTERNAL REFERENCES (BLOCK, NAME)

    0003   FOUR1
    0004   NINTR$
    0005   NRDU$
    0006   NIO1$
    0007   NIO2$
    0010   NWDU$
    0011   SQRT
    0012   ATAN2
    0013   SIN
    0014   COS
    0015   NSTOP$


  STORAGE ASSIGNMENT   (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0000   010020 100F      0000   010022 101F      0000   010032 102F      000
    0000   010037 107F      0001   000024 111G      0001   000033 120G      000
    0001   000114 155G      0001   000147 170G      0001   000162 177G      000
    0000 R 010016 AMEAN     0000 R 007060 ASPECH    0000 R 003000 ASPECY    000
    0000 R 000000 DATAY     0000 R 010017 FM        0000 I 010014 I         000
    0000 I 010012 NSIG      0000 R 006000 PSPECH     0000 R 002000 PSPECY    000


00100      1*     C*************************************************************
00100      2*     C       DIMENSION VARIABLES.
00100      3*     C*************************************************************
00101      4*             DIMENSION DATAY(2,512),PSPECY(512),ASPECY(512),
00101      5*           1          DATAH(2,512),PSPECH(512),ASPECH(512),
00101      6*           2          PTS(8)
00101      7*     C*************************************************************
00101      8*     C       ASSIGN FOLLOWING --
00101      9*     C*************************************************************
00103     10*             NPTS = 8
00104     11*             NPWR = 512
00105     12*             NSIG = 256
00106     13*             CONST = 5.8468
00106     14*     C*************************************************************
00106     15*     C       READ IN POINTS.
00106     16*     C*************************************************************
00107     17*             READ (5,100) (PTS(I),I=1,NPTS)
00115     18*     100     FORMAT(4F16.3)
00116     19*             SUM = 0.0
00117     20*             DO 1 I = 1,NPTS
00122     21*             SUM = SUM + PTS(I)
00123     22*     1       CONTINUE
00125     23*             AMEAN = SUM / FLOAT(NPTS)
00126     24*             WRITE(6,101)
00130     25*     101     FORMAT (' THE FOLLOWING POINTS - MEAN WERE READ: ')
00131     26*             DO 2 I = 1,NPTS
00134     27*             PTS(I) = PTS(I) - AMEAN
```

```
00135    28*              WRITE (6,102) I,PTS(I)
00141    29*      102     FORMAT(' POINT(',I3,')= ',F16.3)
00142    30*      2       CONTINUE
00142    31*      C************************************************************
00142    32*      C       GENERATE Y POINT ARRAY.
00142    33*      C************************************************************
00144    34*              DO 3 I = 1,8
00147    35*              DATAY(1,I) = PTS(I)
00150    36*              DATAY(2,I) = 0.00000
00151    37*      3       CONTINUE
00151    38*      C************************************************************
00151    39*      C       COMPUTE FFT, POWER SPECTRA AND ANGLE SPECTRA OF Y.
00151    40*      C************************************************************
00153    41*              CALL FOUR1(DATAY,NPWR,+1)
00154    42*              DO 5 I = 1,NPWR
00157    43*              PSPECY(I) = DATAY(1,I)**2 + DATAY(2,I)**2
00160    44*              PSPECY(I) = SQRT(PSPECY(I))
00161    45*              PSPECH(I) = PSPECY(I)
00162    46*              ASPECY(I) = ATAN2(DATAY(2,I),DATAY(1,I))
00163    47*      5       CONTINUE
00163    48*      C************************************************************
00163    49*      C       SET POINTS FOR X.
00163    50*      C************************************************************
00165    51*              ASPECH(1) = 0.00000
00166    52*              FM = 0.00000
00167    53*              DO 6 I = 2,NPWR
00172    54*              FM = FM + CONST
00173    55*              ASPECH(I) = SIN(FM)
00174    56*      6       CONTINUE
00174    57*      C************************************************************
00174    58*      C       COMPUTE POINTS FOR H.
00174    59*      C************************************************************
00176    60*              DO 8 I = 1,NPWR
00201    61*              ASPECH(I) = ASPECY(I) - ASPECH(I)
00202    62*              DATAH(1,I) = PSPECH(I) * COS(ASPECH(I))
00203    63*              DATAH(2,I) = PSPECH(I) * SIN(ASPECH(I))
00204    64*      8       CONTINUE
00204    65*      C************************************************************
00204    66*      C       COMPUTE INVERSE FFT OF H.
00204    67*      C************************************************************
00206    68*              CALL FOUR1(DATAH,NPWR,-1)
00207    69*              DO 10 I = 1,NPWR
00212    70*              PSPECH(I) = DATAH(1,I)**2 + DATAH(2,I)**2
00213    71*              PSPECH(I) = SQRT(PSPECH(I))
00214    72*              ASPECH(I) = ATAN2(DATAH(2,I),DATAH(1,I))
00215    73*      10      CONTINUE
00217    74*              WRITE(6,107)
00221    75*      107     FORMAT(28X,'SPECTRA OF INVERSE DATA H.')
00222    76*              WRITE (6,105)
00224    77*      105     FORMAT (1H1,1X,' FREQUENCY',2X,' POWER SPECTRA',2X,
00224    78*              1' ANGLE SPECTRA')
00225    79*              DO 11 I = 1,NSIG
00230    80*              WRITE(6,106) I,PSPECH(I),ASPECH(I)
00235    81*      106     FORMAT (1X,I12,2X,F14.3,2X,F14.3)
00236    82*      11      CONTINUE
00240    83*              STOP
00241    84*              END

         END OF COMPILATION:       NO  DIAGNOSTICS.
```

@MAP,IN   .MAP,.ABS
MAP 0023-04/04-13:47 -(,0)

@XQT-.ABS
 THE FOLLOWING POINTS - MEAN WERE READ:
 POINT(1)=   .450
 POINT(2)=   .268
 POINT(3)=   .120
 POINT(4)=   -.001
 POINT(5)=   -.101
 POINT(6)=   -.182
 POINT(7)=   -.249
 POINT(8)=   -.304
                        SPECTRA OF INVERSE DATA H.

FREQUENCY	POWER SPECTRA	ANGLE SPECTRA	FREQUENCY	POWER SPECTRA	ANGLE SPECTRA
1	176.151	-.001	62	.676	1.525
2	104.849	-.001	63	.637	1.458
3	46.866	-.001	64	.614	1.374
4	.539	-3.135	65	.609	1.270
5	39.716	3.141	66	.631	1.145
6	71.451	-3.141	67	.692	1.006
7	97.701	3.141	68	.821	.858
8	119.250	3.141	69	1.078	.713
9	.173	2.198	70	1.627	.588
10	.200	2.114	71	3.165	.486
11	.231	2.050	72	26.921	.392
12	.264	2.000	73	11.340	.407
13	.301	1.960	74	1.523	.553
14	.341	1.927	75	5.407	-2.803
15	.386	1.901	76	10.330	-2.781
16	.435	1.879	77	13.604	-2.774
17	.491	1.860	78	15.481	-2.772
18	.553	1.845	79	15.470	-2.772
19	.624	1.832	80	3.193	.433
20	.706	1.821	81	1.530	.495
21	.801	1.811	82	.967	.558
22	.911	1.803	83	.687	.620
23	1.042	1.796	84	.523	.685
24	1.198	1.790	85	.418	.752
25	1.388	1.785	86	.346	.818
26	1.623	1.781	87	.294	.886
27	1.917	1.777	88	.257	.953
28	2.295	1.774	89	.228	1.019
29	2.793	1.771	90	.206	1.085
30	3.470	1.769	91	.189	1.150
31	4.428	1.767	92	.177	1.215
32	5.860	1.766	93	.167	1.280
33	8.171	1.764	94	.160	1.345
34	12.369	1.764	95	.156	1.411
35	21.887	1.763	96	.154	1.478
36	62.372	1.761	97	.155	1.545
37	44.452	-1.380	98	.159	1.614
38	64.118	-1.380	99	.166	1.683
39	64.698	-1.379	100	.179	1.750
40	56.437	-1.379	101	.199	1.817
41	42.295	-1.379	102	.229	1.882
42	23.350	-1.379	103	.277	1.942
43	3.321	1.764	104	.356	1.997
44	59.536	1.761	105	.500	2.047
45	19.782	1.762	106	.818	2.088
46	11.325	1.762	107	2.005	2.118
47	7.582	1.761	108	2.930	-.985
48	5.503	1.760	109	3.181	-.985
49	4.201	1.758	110	2.732	-.983
50	3.323	1.755	111	2.017	-.979
51	2.700	1.752	112	1.147	-.967
52	2.241	1.747	113	.165	-.805
53	1.891	1.741	114	1.041	2.116
54	1.619	1.734	115	3.067	2.134
55	1.403	1.724	116	.861	2.116
56	1.229	1.712	117	.494	2.095
57	1.087	1.696	118	.339	2.072
58	.970	1.676	119	.254	2.052
59	.873	1.651	120	.201	2.031
60	.793	1.618	121	.166	2.011
61	.728	1.577	122	.140	1.992
			123	.122	1.973

124	.107	1.955	186	.052	2.420
125	.096	1.938	187	.019	2.251
126	.087	1.922	188	.015	2.191
127	.079	1.905	189	.014	2.163
128	.073	1.889	190	.013	2.150
129	.068	1.872	191	.012	2.144
130	.064	1.855	192	.012	2.142
131	.060	1.835	193	.011	2.143
132	.057	1.814	194	.011	2.147
133	.054	1.789	195	.011	2.152
134	.052	1.760	196	.010	2.158
135	.051	1.724	197	.010	2.164
136	.050	1.679	198	.010	2.171
137	.050	1.622	199	.010	2.178
138	.051	1.548	200	.010	2.186
139	.055	1.453	201	.009	2.194
140	.062	1.330	202	.009	2.202
141	.080	1.181	203	.009	2.210
142	.130	1.010	204	.009	2.217
143	.566	.815	205	.009	2.225
144	.136	.979	206	.009	2.233
145	.087	-2.702	207	.009	2.240
146	.211	-2.503	208	.008	2.246
147	.283	-2.467	209	.008	2.251
148	.314	-2.456	210	.008	2.253
149	.307	-2.455	211	.008	2.250
150	.247	-2.474	212	.008	2.237
151	.157	.905	213	.008	2.191
152	.077	1.057	214	.010	1.931
153	.053	1.186	215	.008	2.359
154	.042	1.295	216	.007	2.589
155	.036	1.387	217	.007	2.710
156	.031	1.465	218	.007	2.762
157	.028	1.530	219	.007	2.761
158	.026	1.584	220	.007	2.712
159	.025	1.630	221	.007	2.592
160	.023	1.670	222	.008	2.178
161	.022	1.704	223	.007	2.322
162	.021	1.734	224	.007	2.373
163	.021	1.761	225	.007	2.404
164	.020	1.785	226	.007	2.427
165	.019	1.807	227	.007	2.447
166	.019	1.828	228	.007	2.463
167	.018	1.847	229	.007	2.483
168	.018	1.866	230	.006	2.498
169	.017	1.884	231	.006	2.513
170	.017	1.902	232	.006	2.527
171	.017	1.920	233	.006	2.541
172	.017	1.940	234	.006	2.554
173	.016	1.962	235	.006	2.567
174	.016	1.987	236	.006	2.579
175	.017	2.019	237	.006	2.594
176	.017	2.063	238	.006	2.608
177	.019	2.128	239	.006	2.622
178	.027	2.249	240	.006	2.635
179	.037	-.430	241	.006	2.649
180	.031	-.398	242	.006	2.663
181	.020	-.287	243	.006	2.677
182	.009	.142	244	.006	2.691
183	.009	1.750	245	.006	2.705
184	.020	2.229	246	.006	2.719
185	.033	2.357	247	.006	2.733

248	.006	2.747
249	.006	2.761
250	.005	2.767
251	.005	2.784
252	.006	2.800
253	.006	2.816
254	.006	2.832
255	.006	2.846
256	.006	2.861