IUE Orbital Elements IV

This report extends the previous compendium of IUE orbital elements (Imhoff and Butschky 1985) through May 1989. These elements can be used to derive radial velocity corrections as discussed by Jenkins (1979), Harvel (1980) and Schiffer (1982).

Table 1 is the list of orbital elements. Each epoch is given as year, month, and day of the orbit determination in the format YYMMDD, for 00:00 GMT. The semi-major axis (a) is given in kilometers. The orbital period (P) may be found from the equation

$$P = 1.6586 \times 10^{-4} a^{3/2} \text{ minutes.}$$

The eccentricity is unitless. The inclination, longitude of the ascending node, argument of perigee, and mean anomaly are given in degrees.

The orbit of IUE is continually changing due to anomalies in the Earth's gravitational field. For this reason the orbital elements also change and are updated frequently. In addition, the satellite must be kept within the field of view of the receiving antennae, both at Goddard Space Flight Center and at Villafranca, Spain. When the spacecraft drifts too far west, the orbit is corrected using the hydrazine jets. This corrective maneuver ("delta V") causes the spacecraft drift to reverse direction and drift eastward. The changes in the drift direction represent discontinuities in the orbital elements, particularly the semi-major axis. Table 1 includes the dates of delta V maneuvers. When deriving radial velocity corrections, caution should be taken in interpolating values near the times of these discontinuities in order to ensure accurate results. Table 2 lists the dates (YYMMDD) and GMT times at which the corrective maneuvers were performed.

In addition, the orbital elements are recorded in line 83 of the Image Header, as of July 8 1983 at GSFC. These are the most current orbital elements for the observation date, as used in the ground command computer. The format is the following: epoch of the orbit (Julian date), seconds, semi-major axis (kilometers), eccentricity, inclination (degrees), longitude of the ascending node (degrees), argument of perigee (degrees), and mean anomaly (degrees). For all of these elements except the epoch, 8 characters are recorded in floating point format with no delineations between the elements. An example is given in Figure 1.

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20 June 1989

References

Broude, S.M. and Bradley, R.E. 1984, NASA IUE Newsletter, No. 24, p. 131
Ehlers, R. 1981, NASA IUE Newsletter, No. 14, p. 100
Jenkins, E.B. 1979, NASA IUE Newsletter, No. 5, p. 23
Harvel, C. 1980, NASA IUE Newsletter, No. 10, p. 32
Imhoff, C.L. and Butschky, M. T. 1985, NASA IUE Newsletter, No. 26, p. 42
Schiffer, F H., III 1982, Data Analysis Procedures for the IUE RDAF (Part I), p. 3-8
Turnrose, B.E. and Thompson, R.W. 1984, IUE Image Processing Information Manual, p. 9-3

Table 1a

IUE Orbital Elements 1985

Epoch (yymmdd)	Semi-Major Axis (kilometers)	Eccentricity	Inclination (degrees)	Ascending Node (longitude)	Arg of Perigee (degrees)	Mean Anomaly (degrees)
841201	42156.4	0.2035784	029.321	155.720	308.837	265.044
841214	42157.3	0.2035716	029.345	155.429	309.174	279.424
841227	42157.8	0.2033677	029.374	155.149	309.483	293.631
850108	42158.1	0.2032300	029.402	154.906	309.800	306.501
850121	42158.9	0.2027660	029.440	154.658	310.103	320.283
850202	42160.6	0.2023252	029.465	154.430	310.347	332.816
850215	42162.3	0.2016877	029.496	154.187	310.610	346.218
850227	42163.4	0.2010492	029.513	154.008	310.786	358.414
850325	42166.8	0.1999762	029.532	153.556	311.158	024.335
850407	42168.0	0.1996296	029.524	153.312	311.358	037.023
850419	42169.6	0.1993739	029.523	153.085	311.519	048.595
850501	42170.6	0.1993815	029.526	152.834	311.775	059.957
850527	42171.0	0.1993815	029.542	152.284	312.282	084.056
850608	42171.5	0.1993232	029.565	152.022	312.535	094.913
850620	42172.4	0.1992633	029.576	151.791	312.825	105.523
850703	42173.4	0.1989606	029.607	151.501	313.170	116.844
850718 delta V						
850724	42172.4	0.1980627	029.666	151.112	313.711	134.782
850809 delta V						
850809	42151.7	0.1970161	029.711	150.827	313.950	148.509
850822	42152.3	0.1963444	029.732	150.603	314.246	163.285
850903	42153.2	0.1956487	029.758	150.404	314.451	176.806
850915	42154.5	0.1951342	029.773	150.211	314.668	190.151
850929	42156.1	0.1944629	029.772	149.953	314.850	205.618
851011	42158.6	0.1941594	029.769	149.733	315.054	218.667
851025	42160.0	0.1937807	029.775	149.468	315.211	233.763
851106	42161.8	0.1937326	029.764	149.210	315.457	246.426
851202	42163.3	0.1935954	029.783	148.660	315.965	273.265
851214	42163.7	0.1934759	029.809	148.393	316.226	285.375

Table 1b

IUE Orbital Elements 1986

Epoch (yymmdd)	Semi-Major Axis (kilometers)	Eccentricity	Inclination (degrees)	Ascending Node (longitude)	Arg of Perigee (degrees)	Mean Anomaly (degrees)
860108	42166.3	0.1929308	029.871	147.909	316.818	309.911
860121	42167.4	0.1924121	029.911	147.670	317.130	322.352
860202	42168.6	0.1918092	029.942	147.475	317.400	333.627
860228	42171.2	0.1905005	029.990	147.043	317.905	357.543
860312	42172.9	0.1899100	030.006	146.833	318.090	008.366
860319	delta V					
860320	42161.5	0.1900257	030.001	146.681	318.311	015.469
860326	42161.8	0.1895977	030.005	146.588	318.413	021.744
860405	42163.2	0.1894078	030.009	146.393	318.552	032.212
860419	42164.2	0.1892261	030.003	146.126	318.773	046.612
860502	42164.8	0.1890308	030.006	145.861	318.964	059.833
860522	42166.6	0.1888486	030.007	145.464	319.337	079.684
860609	42166.7	0.1888642	030.043	145.077	319.755	097.124
860610	42166.6	0.1888647	030.048	145.057	319.791	098.069
860621	42168.3	0.1886076	030.065	144.837	320.051	108.482
860716	42170.3	0.1878296	030.142	144.379	320.716	131.472
860729	delta V					
860730	42158.7	0.1870004	030.184	144.121	321.000	144.165
860809	42158.2	0.1865474	030.217	143.974	321.272	154.623
860823	42159.7	0.1856917	030.241	143.732	321.547	169.193
860906	42161.2	0.1850352	030.255	143.511	321.824	183.518
860916	42163.4	0.1845594	030.266	143.326	321.985	193.693
860929	42165.1	0.1840644	030.263	143.099	322.201	206.719
861014	42166.8	0.1834544	030.264	142.822	322.401	221.599
861024	42167.0	0.1833754	030.252	142.622	322.559	231.373
861106	42167.7	0.1831582	030.255	142.356	322.758	243.932
861129	42170.4	0.1828377	030.280	141.907	323.202	265.544
861218	delta V					
861219	42152.9	0.1831871	030.335	141.491	323.722	283.852
861226	42154.5	0.1829256	030.350	141.374	323.848	291.757

Table 1c

IUE Orbital Elements 1987

Epoch (yymmdd)	Semi-Major Axis (kilometers)	Eccentricity	Inclination (degrees)	Ascending Node (longitude)	Arg of Perigee (degrees)	Mean Anomaly (degrees)	
870108	42155.3	0.1824722	030.392	141.124	324.169	306.279	
870120	42155.5	0.1820733	030.433	140.926	324.520	319.398	
870202	42156.5	0.1813740	030.470	140.701	324.800	333.509	
870214	42158.1	0.1809734	030.494	140.505	325.093	346.319	
870227	42160.4	0.1803245	030.517	140.283	325.322	000.067	
870311	42162.6	0.1799213	030.516	140.085	325.514	012.592	
870324	42164.1	0.1794419	030.514	139.857	325.691	026.027	
870406	42164.5	0.1790581	030.506	139.620	325.893	039.240	
870420	42165.3	0.1787887	030.510	139.344	326.097	053.306	
870501	42165.8	0.1785923	030.507	139.129	326.271	064.185	
870514	42167.0	0.1784511	030.518	138.870	326.522	076.826	
870527	42168.1	0.1783258	030.535	138.607	326.807	089.259	
870608	42169.2	0.1781916	030.568	138.383	327.123	100.475	
870622	42170.5	0.1778983	030.606	138.102	327.466	113.416	
870703	42170.0	0.1777083	030.646	137.916	327.803	123.311	
870729	42172.2	0.1767205	030.725	137.471	328.501	146.234	
870810	42173.1	0.1761192	030.755	137.275	328.781	156.583	
870909	delta V						
870910	42154.0	0.1741094	030.782	136.774	329.275	182.776	
870916	42156.0	0.1740023	030.784	136.657	329.393	189.430	
870929	42157.0	0.1734264	030.775	136.436	329.592	203.699	
871012	42158.3	0.1729847	030.778	136.192	329.804	217.791	
871025	42159.0	0.1726589	030.773	135.954	330.005	231.690	
871106	42160.1	0.1723908	030.782	135.713	330.210	244.355	
871118	42162.4	0.1722507	030.801	135.480	330.466	256.782	
871202	42163.2	0.1720445	030.828	135.197	330.752	271.109	
871214	42163.8	0.1719504	030.865	134.960	331.119	096.049	***

*** The value of Mean Anomaly for 871214 appears to be in error.

Table 1d

IUE Orbital Elements 1988

Epoch (yymmdd)	Semi-Major Axis (kilometers)	Eccentricity	Inclination (degrees)	Ascending Node (longitude)	Arg of Perigee (degrees)	Mean Anomaly (degrees)
880108	42165.4	0.1713730	030.951	134.522	331.763	307.237
880120	42165.8	0.1709544	030.986	134.320	332.063	318.960
880203	42167.6	0.1703444	031.017	134.099	332.422	332.073
880216	42169.7	0.1697604	031.036	133.887	332.695	344.107
880229	42171.9	0.1691653	031.047	133.678	332.955	355.926
880318	delta V					
880319	42158.5	0.1682720	031.048	133.369	333.384	012.873
880405	42159.9	0.1679041	031.040	133.044	333.667	031.163
880418	42160.9	0.1676083	031.047	132.800	333.868	044.934
880430	42162.3	0.1674658	031.053	132.571	334.129	057.388
880513	42163.4	0.1672540	031.068	132.312	334.392	070.728
880526	42164.1	0.1672850	031.097	132.062	334.706	083.792
880607	42164.3	0.1671182	031.134	131.831	335.016	095.652
880620	42165.1	0.1670084	031.168	131.589	335.589	108.248
880705	42166.3	0.1665002	031.218	131.343	335.791	122.495
880715	42167.6	0.1663217	031.243	131.160	336.090	131.848
880728	42169.2	0.1657968	031.273	130.961	336.423	143.836
880809	42171.1	0.1651958	031.302	130.764	336.760	154.680
880822	42172.2	0.1645054	031.306	130.566	337.065	166.276
880908	delta V					
880909	42154.5	0.1633505	031.332	130.289	337.379	182.215
880917	42154.8	0.1629702	031.318	130.144	337.495	191.164
880930	42156.0	0.1624119	031.320	129.904	337.754	205.515
881012	42157.1	0.1620197	031.318	129.703	337.954	218.574
881024	42158.6	0.1616302	031.325	129.475	338.168	231.512
881105	42160.6	0.1615333	031.344	129.237	338.419	244.251
881118	42162.5	0.1613138	031.367	128.970	338.694	257.879
881130	42162.4	0.1613108	031.394	128.736	338.998	270.217
881213	42162.6	0.1611760	031.439	128.501	339.308	283.390
881226	42163.3	0.1609400	031.467	128.270	339.716	296.261

Table 1e

IUE Orbital Elements 1989

Epoch (yymmdd)	Semi-Major Axis (kilometers)	Eccentricity	Inclination (degrees)	Ascending Node (longitude)	Arg of Perigee (degrees)	Mean Anomaly (degrees)
890108	42164.3	0.1606513	031.515	128.052	340.023	308.985
890202	42168.7	0.1597019	031.570	127.668	340.655	332.791
890213	42169.9	0.1590955	031.589	127.492	340.949	343.037
890227	42170.9	0.1584772	031.600	127.282	341.276	355.902
890313	delta V					
890314	42160.2	0.1581329	031.582	127.031	341.661	009.464
890323	42160.4	0.1576295	031.601	126.862	341.936	018.924
890405	42162.3	0.1572265	031.597	126.641	342.137	032.543
890418	42163.1	0.1570853	031.613	126.392	342.394	045.973
890501	42163.8	0.1569227	031.624	126.148	342.640	059.198
890514	42164.4	0.1568771	031.655	125.891	342.939	072.194
890525	42164.3	0.1569216	031.664	125.673	343.142	083.094

Table 2

IUE Orbit Corrective Maneuvers

Date	Time (GMT)
850718	18:05:30 +/- 1 sec
850809	6:25:30 +/- 1 sec
860319	6:20:56 +/- 1 sec
860729	6:22:15 +/- 1 sec
861218	6:45:12 +/- 1 sec
870909	5:29:35 +/- 1 sec
880318	6:15 +/- 1 min
880908	5:00:05 +/- 1 sec
890313	6:12:54 +/- 1 sec

Figure 1: Orbital elements as listed in line 83 of the Image Header. The fields noted are (a) epoch, (b) seconds, (c) semi-major axis, (d) eccentricity, (e) inclination, (f) ascending node, (g) argument of perigee, and (h) mean anomaly.

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 A  ca    ""                 ] B ] B ].A ] B ] B ]&B               79 C
 X    I                                                            80 C
 1       r    =                                   *                81 C
   (a)      (b)      (c)      (d)       (e)    " (f)     (g)      (h)    82 C
2447207.5          .0 42169.8 .169760 31.0358133.8866-27.3043344.106  83 C
52104830 1054104-6011111902946  52111539 1150230+4650133223649    84 C
52121536 1151 57+4629233221158  52190959 1632291+423219259 820    85 C
    5    fc   -            A  ca   ""   o    /           2A       86 C
    <    fe   -            A3 ba   a  g g g  /           1B       87 C
         f    -            QA3s  ·  M  j j   /           1B       88 C
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