Result Verification (with MSC Nastran)

MBAP Version : Alpha
MSC Nastran Version : 2014.0

1. Linear Static

MBAP :

Node Displacement Result:

Node Coordinate			Node Displacement					
0	0	0	0	0	0	0	0	0
50	0	0	4.7373×10^{-5}	-8.8812×10^{-4}	1.7762×10^{-3}	0	-6.1623×10^{-5}	-3.0811×10^{-5}
100	0	0	9.4745×10^{-5}	-3.1983×10^{-3}	6.3966×10^{-3}	0	-1.1376×10^{-4}	-5.6882×10^{-5}
150	0	0	1.0659×10^{-4}	-6.1005×10^{-3}	1.2201×10^{-2}	0	-1.1635×10^{-4}	-5.8175×10^{-5}
200	0	0	1.1842×10^{-4}	-9.0601×10^{-3}	1.8120×10^{-2}	0	-1.1836×10^{-4}	-5.9181×10^{-5}
300	0	0	2.1317×10^{-4}	-1.6280×10^{-2}	3.2561×10^{-2}	0	-1.5628×10^{-4}	-7.8142×10^{-5}
350	0	0	2.6054×10^{-4}	-2.0365×10^{-2}	4.0729×10^{-2}	0	-1.6102×10^{-4}	-8.0512×10^{-5}

MSC NASTRAN :

D I S P L A C E M E N T V E C T O R

POINT ID.	TYPE	T1	T2	T3	R1	R2	R3
1	G	0.0	0.0	0.0	0.0	0.0	0.0
2	G	4.737271E-05	-8.881206E-04	1.776241E-03	0.0	-6.162268E-05	-3.081134E-05
3	G	9.474542E-05	-3.198303E-03	6.396606E-03	0.0	-1.137650E-04	-5.638248E-05
4	G	1.065851E-04	-6.100458E-03	1.220092E-02	0.0	-1.163505E-04	-5.817526E-05
5	G	1.184247E-04	-9.060069E-03	1.812014E-02	0.0	-1.183615E-04	-5.918076E-05
6	G	2.131701E-04	-1.628057E-02	3.256073E-02	0.0	-1.562432E-04	-7.814158E-05
7	G	2.605428E-04	-2.036453E-02	4.072907E-02	0.0	-1.610234E-04	-8.051169E-05

MBAP :

Element Stress Result:

Node No.	Natural Coord	{-5, -5}	{5, 5}	{5, -5}	{-5, 5}
1	-1	2.2894	-1.89147	-0.497845	0.895776
	0	2.14008	-1.74215	-0.448073	0.846004
	1	1.99076	-1.59283	-0.398301	0.796231
2	-1	1.99076	-1.59283	-0.398301	0.796231
	0	1.84145	-1.44352	-0.348528	0.746459
	1	1.69213	-1.2942	-0.298756	0.696687
3	-1	0.140221	-0.0407683	0.0195616	0.0798915
	0	0.131172	-0.0317189	0.0225781	0.076875
	1	0.122122	-0.0226694	0.0255945	0.0738585
4	-1	0.122122	-0.0226694	0.0255945	0.0738585
	0	0.113073	-0.0136199	0.028611	0.070842
	1	0.104023	-0.0045704	0.0316275	0.0678255
5	-1	1.09486	-0.696934	-0.0996676	0.497598
	0	0.796231	-0.398301	-0.000123284	0.398054
	1	0.497598	-0.0996676	0.099421	0.29851
6	-1	0.497598	-0.0996676	0.099421	0.29851
	0	0.348282	0.0496489	0.149193	0.248738
	1	0.198965	0.198965	0.198965	0.198965

MSC NASTRAN :

S T R E S S E S I N B E A M E L E M E N T S (C B E A M)

ELEMENT-ID	GRID	STAT DIST/ LENGTH	SXC	SXD	SXE	SXF	S-MAX	S-MIN	M.S.-T	M.S.-C
1										
	1	0.000	2.289396E+00	-1.891466E+00	-4.978449E-01	8.957757E-01	2.289396E+00	-1.891466E+00		
	0	0.500	2.140080E+00	-1.742149E+00	-4.480728E-01	8.460035E-01	2.140080E+00	-1.742149E+00		
	2	1.000	1.990763E+00	-1.592833E+00	-3.983006E-01	7.962314E-01	1.990763E+00	-1.592833E+00		
2										
	2	0.000	1.990763E+00	-1.592833E+00	-3.983006E-01	7.962314E-01	1.990763E+00	-1.592833E+00		
	0	0.500	1.841447E+00	-1.443516E+00	-3.485284E-01	7.464592E-01	1.841447E+00	-1.443516E+00		
	3	1.000	1.692130E+00	-1.294200E+00	-2.987563E-01	6.966870E-01	1.692130E+00	-1.294200E+00		
3										
	3	0.000	1.402214E-01	-4.076834E-02	1.956156E-02	7.989145E-02	1.402214E-01	-4.076834E-02		
	0	0.500	1.311719E-01	-3.171886E-02	2.257805E-02	7.687496E-02	1.311719E-01	-3.171886E-02		
	4	1.000	1.221224E-01	-2.266937E-02	2.559454E-02	7.385846E-02	1.221224E-01	-2.266937E-02		
4										
	4	0.000	1.221224E-01	-2.266937E-02	2.559454E-02	7.385846E-02	1.221224E-01	-2.266937E-02		
	0	0.500	1.130729E-01	-1.361989E-02	2.861104E-02	7.084197E-02	1.130729E-01	-1.361989E-02		
	5	1.000	1.040234E-01	-4.570404E-03	3.162753E-02	6.782547E-02	1.040234E-01	-4.570404E-03		
5										
	5	0.000	1.094864E+00	-6.969336E-01	-9.966762E-02	4.975984E-01	1.094864E+00	-6.969336E-01		
	0	0.500	7.962314E-01	-3.983006E-01	-1.232836E-04	3.980540E-01	7.962314E-01	-3.983006E-01		
	6	1.000	4.975984E-01	-9.966762E-02	9.942105E-02	2.985097E-01	4.975984E-01	-9.966762E-02		
6										
	6	0.000	4.975984E-01	-9.966762E-02	9.942105E-02	2.985097E-01	4.975984E-01	-9.966762E-02		
	0	0.500	3.482819E-01	4.964888E-02	1.491932E-01	2.487375E-01	3.482819E-01	4.964888E-02		
	7	1.000	1.989654E-01	1.989654E-01	1.989654E-01	1.989654E-01	1.989654E-01	1.989654E-01		

2. Real Eigenvalue

MBAP :

$$\begin{pmatrix} 9.66102\times10^{6} \\ 9.66102\times10^{6} \\ 5.48263\times10^{7} \\ 2.4437\times10^{8} \\ 2.4437\times10^{8} \\ 4.03163\times10^{8} \\ 1.23174\times10^{9} \\ 1.5107\times10^{9} \\ 1.5107\times10^{9} \\ 3.65643\times10^{9} \\ 6.20506\times10^{9} \\ 6.20506\times10^{9} \\ 1.00634\times10^{10} \\ 1.06732\times10^{10} \\ 1.06732\times10^{10} \\ 1.43466\times10^{10} \\ 2.10999\times10^{10} \\ 2.3828\times10^{10} \\ 2.5343\times10^{10} \\ 2.5343\times10^{10} \end{pmatrix}$$

MSC NASTRAN :

R E A L E I G E N V A L U E S

MODE NO.	EXTRACTION ORDER	EIGENVALUE	RADIANS	CYCLES	GENERALIZED MASS	GENERALIZED STIFFNESS
1	1	9.661016E+06	3.108217E+03	4.946882E+02	1.000000E+00	9.661016E+06
2	2	9.661016E+06	3.108217E+03	4.946882E+02	1.000000E+00	9.661016E+06
3	3	2.443697E+08	1.563233E+04	2.487963E+03	1.000000E+00	2.443697E+08
4	4	2.443697E+08	1.563233E+04	2.487963E+03	1.000000E+00	2.443697E+08
5	5	4.031633E+08	2.007893E+04	3.195661E+03	1.000000E+00	4.031633E+08
6	6	1.510699E+09	3.886772E+04	6.185989E+03	1.000000E+00	1.510699E+09
7	7	1.510699E+09	3.886772E+04	6.185989E+03	1.000000E+00	1.510699E+09
8	8	3.656430E+09	6.046842E+04	9.623848E+03	1.000000E+00	3.656430E+09
9	9	6.205059E+09	7.877220E+04	1.253698E+04	1.000000E+00	6.205059E+09
10	10	6.205059E+09	7.877220E+04	1.253698E+04	1.000000E+00	6.205059E+09
11	11	1.067318E+10	1.033111E+05	1.644247E+04	1.000000E+00	1.067318E+10
12	12	1.067318E+10	1.033111E+05	1.644247E+04	1.000000E+00	1.067318E+10
13	13	2.109992E+10	1.452581E+05	2.311854E+04	1.000000E+00	2.109992E+10
14	14	2.534290E+10	1.591940E+05	2.533664E+04	1.000000E+00	2.534290E+10
15	15	2.534298E+10	1.591948E+05	2.533664E+04	1.000000E+00	2.534298E+10

3. Rotor Critical Speed (Complex Eigenvalue with RotorDynamic)

MBAP :

Log Decrement for the First Four Critical Speed:

Critical Speed(cpm)	Log Decrement
8373.6901	0
17388.884	0
129734.626	1.3031195
254808.86	0

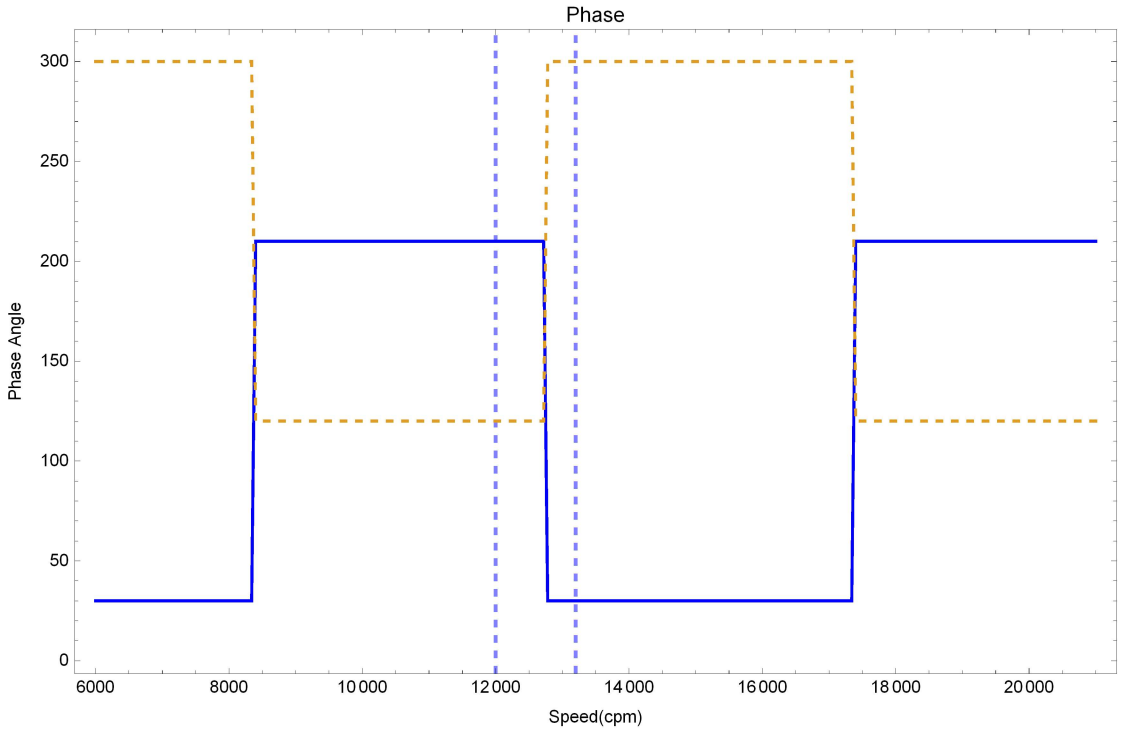
MSC NASTRAN :

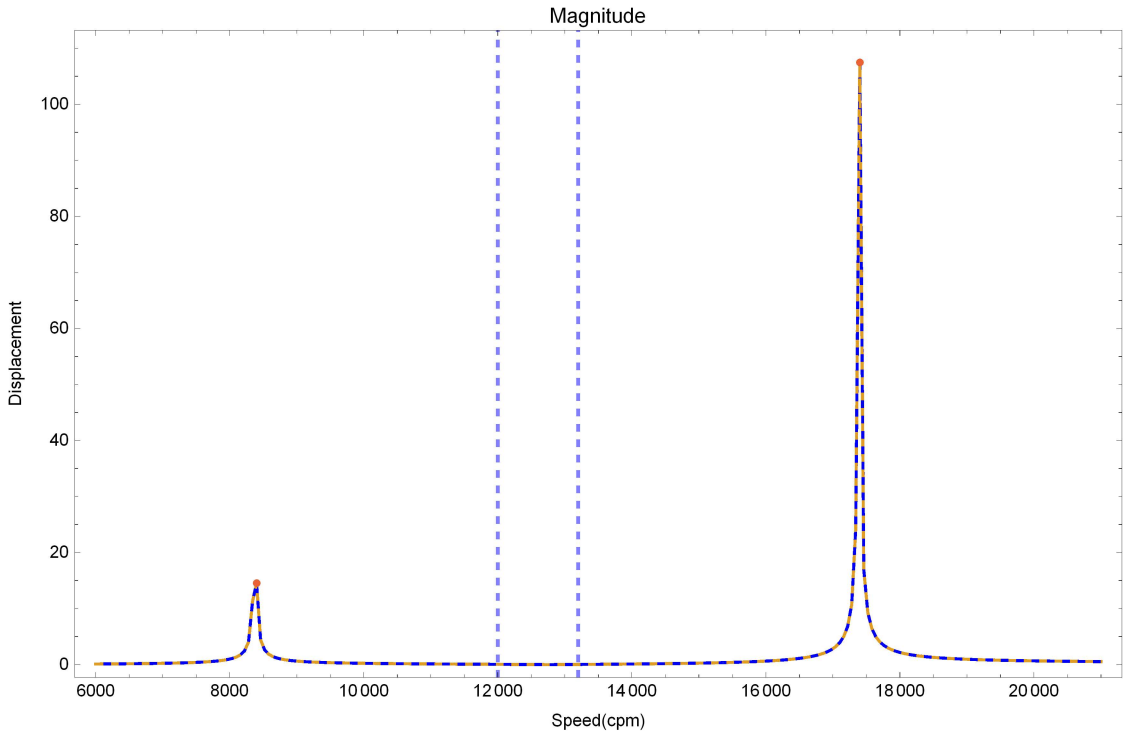
C O M P L E X E I G E N V A L U E S U M M A R Y

ROOT NO.	EXTRACTION ORDER	EIGENVALUE (REAL)	EIGENVALUE (IMAG)	FREQUENCY (CYCLES)	DAMPING COEFFICIENT
1	1	-5.003456E+01	1.201512E-12	1.912266E-13	3.336921E+13
2	2	5.016427E+01	2.575707E-12	4.099493E-13	3.905063E+13
3	3	8.437587E-08	-8.768908E-02	1.395615E+02	-1.935837E-10
4	4	8.475346E-08	8.768908E-02	1.395615E+02	-1.933159E-10
5	5	3.809261E-07	-1.820960E-03	2.898147E+02	-1.183795E-10
6	6	3.810019E-07	1.820960E-03	2.898147E+02	-4.184627E-10
7	7	-2.817662E+03	-1.356578E-04	2.162244E+03	4.147958E-01
8	8	-2.817662E+03	1.356578E-04	2.162244E+03	4.147958E-01
9	9	1.879834E-07	-2.666352E-04	4.246814E+03	-1.408985E-11
10	10	1.879347E-07	2.666352E-04	4.246814E+03	-1.405622E-11
11	11	-3.079135E+04	-5.343071E-11	0.0	0.0
12	12	3.079135E+04	2.052602E-11	0.0	0.0
13	13	-2.276410E+03	-3.299405E-04	5.251167E+03	1.379891E-01
14	14	-2.276410E+03	3.299405E-04	5.251167E+03	1.379891E-01
15	15	-3.831978E+01	5.299056E-09	8.433710E-10	1.166291E+13

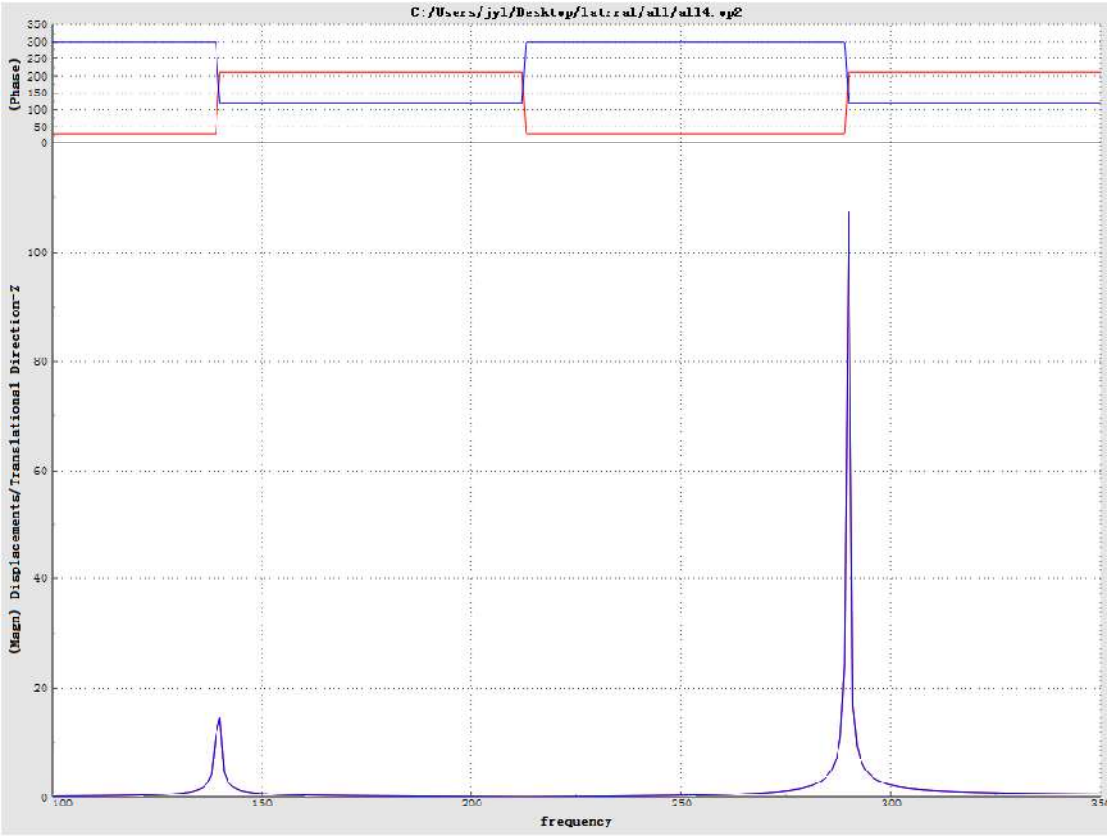
4. Rotor Direct Frequency Response (with RotorDynamic)

MBAP :


Phase
Phase Angle
300
250
200
150
100
50
0
6000
8000
10000
12000
14000
16000
18000
20000
Speed(cpm)


Magnitude
Displacement
100
80
60
40
20
0
6000
8000
10000
12000
14000
16000
18000
20000
Speed(cpm)

MSC NASTRAN :



5. Linear Transient

MBAP :

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.1	0.	0.	0.	0.	0.	0.	0.	0.	0.00342452	0.	0.0000641054	0.	0.	0.	0.0119738	0.	0.000102491	0.	0.	0.	0.0230053	0.	0.00011531	0.
0.2	0.	0.	0.	0.	0.	0.	0.	0.	0.00803807	0.	0.000150347	0.	0.	0.	0.0281037	0.	0.000240551	0.	0.	0.	0.0541827	0.	0.000270617	0.
0.3	0.	0.	0.	0.	0.	0.	0.	0.	0.0142469	0.	-0.000266481	0.	0.	0.	0.0498124	0.	-0.00042637	0.	0.	0.	0.0960371	0.	-0.000479667	0.
0.4	0.	0.	0.	0.	0.	0.	0.	0.	0.0190485	0.	-0.000356292	0.	0.	0.	0.0666005	0.	-0.000570065	0.	0.	0.	0.128404	0.	-0.000641327	0.
0.5	0.	0.	0.	0.	0.	0.	0.	0.	0.0242706	0.	-0.000454117	0.	0.	0.	0.0848066	0.	-0.000726507	0.	0.	0.	0.163659	0.	-0.00081741	0.
0.6	0.	0.	0.	0.	0.	0.	0.	0.	0.0296616	0.	0.000554802	0.	0.	0.	0.103707	0.	0.000887683	0.	0.	0.	0.199915	0.	0.000998641	0.
0.7	0.	0.	0.	0.	0.	0.	0.	0.	0.034813	0.	-0.000651156	0.	0.	0.	0.121718	0.	-0.00104185	0.	0.	0.	0.23467	0.	-0.00117208	0.
0.8	0.	0.	0.	0.	0.	0.	0.	0.	0.0400686	0.	-0.000749458	0.	0.	0.	0.140094	0.	-0.00119913	0.	0.	0.	0.270097	0.	-0.00134903	0.
0.9	0.	0.	0.	0.	0.	0.	0.	0.	0.0453273	0.	-0.00084702	0.	0.	0.	0.15843	0.	-0.00135651	0.	0.	0.	0.305546	0.	-0.00152600	0.
1.	0.	0.	0.	0.	0.	0.	0.	0.	0.0505519	0.	0.000945544	0.	0.	0.	0.176747	0.	0.00151287	0.	0.	0.	0.340765	0.	0.00170198	0.
1.1	0.	0.	0.	0.	0.	0.	0.	0.	0.0557979	0.	-0.00104367	0.	0.	0.	0.195089	0.	-0.00166987	0.	0.	0.	0.376127	0.	-0.0018786	0.
1.2	0.	0.	0.	0.	0.	0.	0.	0.	0.0610404	0.	-0.00114172	0.	0.	0.	0.213419	0.	-0.00182676	0.	0.	0.	0.411466	0.	-0.0020551	0.
1.3	0.	0.	0.	0.	0.	0.	0.	0.	0.0662706	0.	-0.0012397	0.	0.	0.	0.231753	0.	-0.00190352	0.	0.	0.	0.446776	0.	-0.00223146	0.
1.4	0.	0.	0.	0.	0.	0.	0.	0.	0.0715207	0.	0.00133775	0.	0.	0.	0.250062	0.	0.0021404	0.	0.	0.	0.482112	0.	0.00240795	0.
1.5	0.	0.	0.	0.	0.	0.	0.	0.	0.0767616	0.	-0.00143578	0.	0.	0.	0.268385	0.	-0.00229725	0.	0.	0.	0.517441	0.	-0.0025844	0.
1.6	0.	0.	0.	0.	0.	0.	0.	0.	0.082202	0.	-0.0015338	0.	0.	0.	0.286708	0.	-0.00245408	0.	0.	0.	0.552766	0.	-0.00276084	0.
1.7	0.	0.	0.	0.	0.	0.	0.	0.	0.0872431	0.	-0.00163103	0.	0.	0.	0.305033	0.	-0.00261093	0.	0.	0.	0.588096	0.	-0.0029373	0.
1.8	0.	0.	0.	0.	0.	0.	0.	0.	0.0924839	0.	0.00172986	0.	0.	0.	0.323356	0.	0.00276777	0.	0.	0.	0.623423	0.	0.00311374	0.
1.9	0.	0.	0.	0.	0.	0.	0.	0.	0.0977247	0.	-0.00182788	0.	0.	0.	0.34163	0.	-0.00292461	0.	0.	0.	0.658751	0.	-0.00329019	0.
2.	0.	0.	0.	0.	0.	0.	0.	0.	0.102966	0.	-0.00192591	0.	0.	0.	0.360004	0.	-0.00308146	0.	0.	0.	0.694079	0.	-0.00346664	0.

MSC NASTRAN :

POINT-ID = 4

D I S P L A C E M E N T V E C T O R

TIME	TYPE	T1	T2	T3	R1	R2	R3
0.0	G	0.0	0.0	0.0	0.0	0.0	0.0
1.000000E-01	G	0.0	0.0	-2.308516E-02	0.0	1.153050E-04	0.0
2.000000E-01	G	0.0	0.0	-5.418290E-02	0.0	2.706186E-04	0.0
3.000000E-01	G	0.0	0.0	-9.603687E-02	0.0	4.796652E-04	0.0
4.000000E-01	G	0.0	0.0	-1.284045E-01	0.0	6.413284E-04	0.0
5.000000E-01	G	0.0	0.0	-1.636590E-01	0.0	8.174088E-04	0.0
6.000000E-01	G	0.0	0.0	-1.999451E-01	0.0	9.986439E-04	0.0
7.000000E-01	G	0.0	0.0	-2.346701E-01	0.0	1.172081E-03	0.0
8.000000E-01	G	0.0	0.0	-2.700972E-01	0.0	1.349025E-03	0.0
9.000000E-01	G	0.0	0.0	-3.055459E-01	0.0	1.526076E-03	0.0
1.000000E+00	G	0.0	0.0	-3.407646E-01	0.0	1.701979E-03	0.0
1.100000E+00	G	0.0	0.0	-3.761269E-01	0.0	1.878599E-03	0.0
1.200000E+00	G	0.0	0.0	-4.114661E-01	0.0	2.055104E-03	0.0
1.300000E+00	G	0.0	0.0	-4.467762E-01	0.0	2.231464E-03	0.0
1.400000E+00	G	0.0	0.0	-4.821124E-01	0.0	2.407953E-03	0.0
1.500000E+00	G	0.0	0.0	-5.174405E-01	0.0	2.584403E-03	0.0
1.600000E+00	G	0.0	0.0	-5.527659E-01	0.0	2.760839E-03	0.0
1.700000E+00	G	0.0	0.0	-5.880956E-01	0.0	2.937296E-03	0.0
1.800000E+00	G	0.0	0.0	-6.234233E-01	0.0	3.113743E-03	0.0
1.900000E+00	G	0.0	0.0	-6.587509E-01	0.0	3.290190E-03	0.0
2.000000E+00	G	0.0	0.0	-6.940792E-01	0.0	3.466640E-03	0.0