

NAFF

hpNaff

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Numerical Analysis of Fundamental Frequencies (NAFF)

A little command line tool (macOS, Linux, Windows) to perform high-resolution frequency analysis of time series following the Laskar method.

Pre-compiled binaries are available at <https://paloz.marum.de/bitbucket/projects/ESSP/repos/hpnaff/browse/Binaries>.



Note for Windows

Windows version requires installation of [Windows Swift Toolchain](#)

For macOS:

after download, copy 'hpnaff' to a location in your search path,

and add execute permissions by 'chmod a+x ./hpnaff; cp hpnaff /usr/local/bin'.

For convenience: a code-signed .dmg file is also available here: [hpNaff-0.4.0.dmg](#)

Then try it on an [example file](#) that contains a weighted mix of Earth's orbital eccentricity, obliquity and climatic precession.



Prototype WebApp version

A prototype (alpha) version (without any of the options) of this tool via a WebApp is available at <https://paloz.marum.de/hpNaffWeb/index.html>

Please drag and drop a tab-separated textfile (two columns only, evenly spaced) onto the area, adjust the time/depth step, and press compute.

Usage:

```
% ./hpnaff -v
Welcome to hpNAFF Analysis. ©2015-2021 Heiko Pälke. 3rd party licenses: see --licenses option
Please provide exactly one file name argument
Usage: hpnaff [options] file
file format: tab separated columns, data must be equidistantly spaced. Instead of file can specify '-' for stdin.
-h, --help:
  Displays help message.
-r, --fracRMSChangeLimit:
  fracRMSChangeLimit. Default: 0.000002
-f, --fracFreqAccuracyLimit:
  fracFreqAccuracyLimit. Default: 0.00000001
-m, --maxFrequencies:
  maxFrequencies. Default: 30
-c, --freqCycleLimit:
  freqCycleLimit. Default: 100
-l, --lowerFreqLimit:
  lowerFreqLimit. Default: 0.0
-u, --upperFreqLimit:
  upperFreqLimit. Default: 0.5 (NYQUIST)
-d, --detrendingOrder:
  Order for polynomial detrending. 0 removes DC only. >0 removes a polynomial fit. Default: not set
-dC, --detrendChunks:
  Option to apply detrending (-d) to individual chunks. Default: false
-fAL, --filterAbscissaLower:
  filter on Abscissa (x-axis) data greater or equal than value specified.
-fAU, --filterAbscissaUpper:
  filter on Abscissa (x-axis) data lesser or equal than value specified.
-s, --chunkSize:
  Split the input file into chunks of this size. Default: not set, no chunking
-w, --window_offsets:
  Specify windowing offset for evolutive analysis. Default: chunkSize if set, or None.
-z, --columnSeparator:
  Use this as columns separator for input file instead of default tab \t. Default: \t
-k, --skipHeaderLines:
  Specify number of (header)lines to be skipped. Default: 0
-n, --decimate:
  Specify decimation of input data. Default: 1 (take every value)
-a, --abscissaColumn:
  Specify column number for abscissa (time or depth). Default: 1
-o, --ordinateColumn:
  Specify column number for ordinate (data). Default: 2
-C, --complex:
  Compute spectra for complex input. Default: false. If true, by default takes values from abscissa column +
1.
-Co, --ComplexOrdinateColumn:
  Specify column number for ordinate (data), complex part. Default: 3 (if C option used)
-t, --deltaT:
  Specify time/depth offset between data. Default: 1.0
-x, --ratios:
  Compute and output frequency ratio matrix. Default: false.
--ratio_list:
  If ratio_option is set, provides comma separated list of frequency ratios to highlight in output.
--output_detrended_data:
  Output detrended data to this filename. Not implemented yet.
--version:
  Shows current version and build of this software
-v, --verbose:
  Print verbose messages. Specify multiple times to increase verbosity.
--references:
  Shows references to papers and sources.
--licenses:
  Shows licenses of code components used in this software.
```

Example: Try it on a sample file: etp_1kyr_36Ma.txt

```
user$ ./hpnaff etp_1kyr_36Ma.txt -d 1 -m 75
```

```
=====
# | chunk |      t0      | points | frequency | amplitude | phase | significance |
period | arcsec/yr | phase (deg) |
0 | 0 | 0.0000 | 14001 | 0.000000000 | 0.00000000 | 0.000000000 | 0.000000000 |
inf | 0.0000000 | 0.0000000 |
1 | 0 | 0.0000 | 14001 | 0.002472456 | 0.75721258 | 3.740563127 | 0.795224850 |
404.45610756 | 3.2043032 | 214.3184802 |
2 | 0 | 0.0000 | 14001 | 0.010522542 | 0.59639514 | -0.083030087 | 0.840326031 |
95.03406718 | 13.6372149 | -4.7572736 |
3 | 0 | 0.0000 | 14001 | 0.024999241 | 0.53877772 | 5.657761056 | 0.827374133 |
40.00121445 | 32.3990163 | 324.1658300 |
4 | 0 | 0.0000 | 14001 | 0.008040668 | 0.50803290 | 2.884638325 | 0.832167805 |
124.36778406 | 10.4207051 | 165.2776014
```

5	0	0.0000	14001	0.010102115	0.39766702	4.191460276	0.868275179
98.98917382	13.0923408	240.1529838					
6	0	0.0000	14001	0.042828239	0.31115152	1.466354530	0.901608023
23.34908056	55.5053976	84.0159259					
7	0	0.0000	14001	0.007627856	0.30706911	0.558756463	0.900168886
131.09844523	9.8857008	32.0143871					
8	0	0.0000	14001	0.000407279	0.27097231	2.625060814	0.917986628
2455.31930796	0.5278336	150.4049056					
9	0	0.0000	14001	0.045302069	0.26148887	5.142663822	0.908826103
22.07404698	58.7114815	294.6529325					
10	0	0.0000	14001	0.025832617	0.23907704	3.749692849	0.917331368
38.71075060	33.4790718	214.8415747					
11	0	0.0000	14001	0.001034652	0.22887920	0.316263467	0.926607014
966.50814962	1.3409095	18.1205619					
12	0	0.0000	14001	0.053350844	0.23311864	1.355155680	0.912974999
18.74384580	69.1426943	77.6447010					
13	0	0.0000	14001	0.009911387	0.18079485	5.692179885	0.941223401
100.89404923	12.8451580	326.1378837					
14	0	0.0000	14001	0.019210470	0.15673509	-0.475810951	0.949106113
52.05494759	24.8967689	-27.2619593					
15	0	0.0000	14001	0.052929481	0.14841497	5.755575872	0.947991689
18.89306257	68.5966076	329.7702061					
16	0	0.0000	14001	0.009488271	0.15112041	-0.166596764	0.960411285
105.39327551	12.2967997	-9.5452915					
17	0	0.0000	14001	0.025098798	0.17311913	2.629896209	0.958954086
39.84254538	32.5280423	150.6819533					
18	0	0.0000	14001	0.025414340	0.14355863	4.818018103	0.948646430
39.34786366	32.9369851	276.0521029					
19	0	0.0000	14001	0.024888808	0.14098312	5.710170222	0.964800625
40.17870229	32.2558949	327.1686540					
20	0	0.0000	14001	0.010323185	0.13699989	-1.010239654	0.950068676
96.86932826	13.3788478	-57.8824685					
21	0	0.0000	14001	0.007440236	0.12986997	2.040413354	0.952028440
134.40433245	9.6425463	116.9070736					
22	0	0.0000	14001	0.001455303	0.12708837	2.315320953	0.947284449
687.14223688	1.8860724	132.6581188					
23	0	0.0000	14001	0.010925100	0.11817448	-0.359553604	0.955088752
91.53234018	14.1589300	-20.6009040					
24	0	0.0000	14001	0.009667251	0.11874251	2.622499903	0.954076811
103.44202802	12.5287567	150.2581762					
25	0	0.0000	14001	0.010413463	0.09715315	2.916722459	0.980490597
96.02953115	13.4958485	167.1158869					
26	0	0.0000	14001	0.000901134	0.09569726	1.601650029	0.968540900
1109.71245232	1.1678701	91.7677869					
27	0	0.0000	14001	0.012994167	0.10086003	0.611296497	0.967944111
76.95760564	16.8404408	35.0247093					
28	0	0.0000	14001	0.042724400	0.09486676	1.049712893	0.980633322
23.40582906	55.3708222	60.1441185					
29	0	0.0000	14001	0.000231340	0.09813349	0.120421080	0.967044518
4322.64694648	0.2998163	6.8996196					
30	0	0.0000	14001	0.005563540	0.10009924	2.397732816	0.967425007
179.74168484	7.2103475	137.3799708					
31	0	0.0000	14001	0.010638958	0.09688648	-0.508419978	0.964555303
93.99417100	13.7880891	-29.1303190					
32	0	0.0000	14001	0.008918727	0.08741944	2.593049312	0.963917464
112.12362149	11.5586705	148.5707817					
33	0	0.0000	14001	0.007853668	0.09431921	1.158980960	0.966015093
127.32903632	10.1783540	66.4047175					
34	0	0.0000	14001	0.024592220	0.08828171	3.104291584	0.962948350
40.66326600	31.8715176	177.8628061					
35	0	0.0000	14001	0.008385587	0.08641115	2.992612020	0.964466604
119.25223732	10.8677206	171.4640385					
36	0	0.0000	14001	0.018145511	0.08763660	3.810401603	0.965100179
55.11004768	23.5165828	218.3199301					
37	0	0.0000	14001	0.024810831	0.08240291	4.521072773	0.982190253
40.30497880	32.1548364	259.0383888					
38	0	0.0000	14001	0.042929640	0.09470460	-1.714770886	0.974168391
23.29392958	55.6368128	-98.2491346					
39	0	0.0000	14001	0.001312871	0.08074684	0.777678607	0.975863805
761.68923898	1.7014813	44.5577020					
40	0	0.0000	14001	0.002884917	0.08065197	2.947032331	0.969528197
346.63039200	3.7388528	168.8525146					
41	0	0.0000	14001	0.009282092	0.07995912	-0.902914836	0.959472393
107.73432964	12.0295917	-51.7332094					
42	0	0.0000	14001	0.002172887	0.07898195	1.985388299	0.966843584
460.21714558	2.8160620	113.7543702					
43	0	0.0000	14001	0.025182288	0.07351399	1.270869502	0.989395181
39.71045117	32.6362447	72.8154588					
44	0	0.0000	14001	0.002006049	0.07122474	1.007509645	0.970121706
498.49230512	2.5998395	57.7260505					
45	0	0.0000	14001	0.008233354	0.07018462	4.902075131	0.962605563
121.45718541	10.6704267	280.8682159					
46	0	0.0000	14001	0.043838032	0.06715352	3.232504867	0.965810782
22.81124276	56.8140900	185.2088861					

47		0		0.0000		14001		0.007224019		0.06531452		4.276908703		0.978785703	
138.42710917				9.3623280		245.0488180									
48		0		0.0000		14001		0.045402169		0.07436495		2.063108445		0.977076727	
22.02537938				58.8412112		118.2074066									
49		0		0.0000		14001		0.002344771		0.06402237		1.101819579		0.974716549	
426.48086343				3.0388233		63.1296117									
50		0		0.0000		14001		0.034012471		0.06632261		0.311286623		0.964879805	
29.40098080				44.0801621		17.8354097									
51		0		0.0000		14001		0.000615717		0.06955959		0.324652566		0.966238480	
1624.12260860				0.7979693		18.6012218									
52		0		0.0000		14001		0.024999132		0.06125458		3.871230190		0.987944595	
40.00138890				32.3988750		221.8051514									
53		0		0.0000		14001		0.012584554		0.06352103		4.354136361		0.970616108	
79.46248859				16.3095823		249.4736369									
54		0		0.0000		14001		0.007042302		0.05954369		3.178070923		0.967975779	
141.99901671				9.1268238		182.0900509									
55		0		0.0000		14001		0.053168977		0.06126971		-0.361831203		0.974607869	
18.80796025				68.9069938		-20.7314008									
56		0		0.0000		14001		0.018476857		0.05675901		1.358226583		0.977498040	
54.12175935				23.9460065		77.8206508									
57		0		0.0000		14001		0.025289765		0.06621217		-0.908124254		0.973848255	
39.54168736				32.7755361		-52.0316871									
58		0		0.0000		14001		0.045202487		0.05979910		4.539755712		0.986931113	
22.12267664				58.5824230		260.1088423									
59		0		0.0000		14001		0.001552070		0.05459046		3.384103161		0.981459103	
644.30080647				2.0114828		193.8948286									
60		0		0.0000		14001		0.010774958		0.06013873		-0.920994981		0.970525666	
92.80778711				13.9643455		-52.7691253									
61		0		0.0000		14001		0.035180014		0.05381168		6.108664303		0.971837152	
28.42523015				45.5932984		350.0006830									
62		0		0.0000		14001		0.025932854		0.05497186		0.528441367		0.981080756	
38.56112370				33.6089791		30.2774600									
63		0		0.0000		14001		0.019098347		0.05289607		5.666427635		0.977106362	
52.36055271				24.7514576		324.6623884									
64		0		0.0000		14001		0.052829237		0.05592637		4.622260192		0.978276065	
18.92891225				68.4666917		264.8360008									
65		0		0.0000		14001		0.011547573		0.05030718		3.661455364		0.969207741	
86.59828253				14.9656548		209.7859392									
66		0		0.0000		14001		0.052667555		0.04771644		4.565272429		0.975236135	
18.98702155				68.2571512		261.5708425									
67		0		0.0000		14001		0.008514638		0.04804064		4.938804770		0.978348985	
117.44480713				11.0349707		282.9726692									
68		0		0.0000		14001		0.017723966		0.04660213		1.785804511		0.976900743	
56.42078067				22.9702600		102.3190615									
69		0		0.0000		14001		0.013408861		0.04526629		-0.218064195		0.976731996	
74.57754915				17.3778840		-12.4941580									
70		0		0.0000		14001		0.004944881		0.04401069		3.792380702		0.977679719	
202.22932980				6.4085660		217.2874085									
71		0		0.0000		14001		0.024477668		0.04221972		2.795577253		0.982047896	
40.85356574				31.7230571		160.1747779									
72		0		0.0000		14001		0.025733760		0.04584982		3.159868039		0.992264403	
38.85945885				33.3509534		181.0471025									
73		0		0.0000		14001		0.044937430		0.04272239		0.214967789		0.979100871	
22.25316390				58.2389096		12.3167471									
74		0		0.0000		14001		0.018373301		0.04170326		4.267372537		0.976418419	
54.42680232				23.8117976		244.5024360									
75		0		0.0000		14001		0.016041231		0.04508949		2.028721000		0.980103195	
62.33935561				20.7894353		116.2371511									

Notes

"Evolutive" outputs can be obtained with the -s option, e.g. -s 1000 computes an analysis for every 1000 points.

Source code available at repository below. Note: There are three branches, "main" contains a new swift package manager version, which can also be compiled for Linux/Windows, and "Accelerate" whichh uses the LinearAlgebra system library. The Linux version is linked statically. The "Windows" branch is modified to enable compilation with the Windows Swift Toolchain (see top).

<https://paloz.marum.de/bitbucket/scm/essp/hpnaff.git>

This is a Swift implementation of

<https://ops.aps.anl.gov/manuals/SDDStoolkit/SDDStoolkitsu61.html>

Related efforts:

<https://github.com/MichaelEhrlichman/FortNAFF>

<https://github.com/adrn/SuperFreq>

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