**SnagPy**

**Programming Guide**

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# **Introduction**

SnagPy is a Python package devoted mainly to the gravitational signal analysis. It derives from the Snag Matlab toolbox (which derived from the Fortran program Snag).

# **Python basic packages**

The following basic packages are used:

* numpy
* scipy
* matplotlib
* random

# **gd class**

# **gd2 class**

# **bsd class**

# **Appendix**

## **General Rules**

General rules and conventions for Snag

### **Matlab rules**

**Matrices**A matrix **M(n,m)** has **n** rows and **m** columns. Data are written in columns, so as  
M(:,1)  
M(:,2)  
M(:,3)  
Example:  
>> a=1:12;  
>> aa=reshape(a,4,3) % 4 rows, 3 columns  
aa =  
1 5 9  
2 6 10  
3 7 11  
4 8 12  
>> aa(:) % the natural way is by columns  
ans =  
1 2 3 4 5 6 7 8 9  
10  
11  
12

### **Signal processing**

**Spectra**The spectra are bilateral.  
**Fourier transform**The definition we use is:  
For the Discrete Fourier Transform we use:  
and for the inverse  
**Attention: this is the Matlab definition. The Numerical Recipes definition is with the  
plus sign in the exponent for the direct DFT.  
In case of ambiguity a parameter fftsign = 1 or -1 is defined.**

### **Time and astronomy**

**Time**The time is in MJD (Modified Julian Date), defined as  
MJD = JD - 2400000.5  
This is easily related to the usual time expression (year, month, day, hour, minute, second)  
and to the way astronomers express absolute time.  
For particular cases, when uniform time is needed, (for example for precise time duration),  
TAI or GPS time can be used, but it must be converted for many functions.  
**Sidereal hour**Normally the Greenwich sidereal hour is used. It should be expressed in hours (preferably)  
or in degrees.  
Given below is a simple algorithm for computing apparent sideral time to an accuracy of  
about 0.1 second, equivalent to about 1.5 arcseconds on the sky. The input time required  
by the algorithm is represented as a Julian date (Julian dates can be used to to determine  
Universal Time.)  
Let JD be the Julian date of the time of interest. Let JD0 be the Julian date of the  
previous midnight (0h) UT (the value of JD0 will end in .5 exactly), and let H be the hours  
of UT elapsed since that time. Thus we have JD = JD0 + H/24.  
For both of these Julian dates, compute the number of days and fraction (+ or -) from  
2000 January 1, 12h UT, Julian date 2451545.0:

|  |
| --- |
| D = JD - 2451545.0 D0 = JD0 - 2451545.0 |

Then the Greenwich mean sidereal time in hours is

|  |
| --- |
| GMST = 6.697374558 + 0.06570982441908 D0 + 1.00273790935 H + 0.000026 T2 |

where T = D/36525 is the number of *centuries* since the year 2000; thus the last term can be  
omitted in most applications. It will be necessary to reduce GMST to the range 0h to 24h.  
Setting H = 0 in the above formula yields the Greenwich mean sidereal time at 0h UT, which  
is tabulated in *The Astronomical Almanac*.  
The following alternative formula can be used with a loss of precision of 0.1 second per  
century:

|  |
| --- |
| GMST = 18.697374558 + 24.06570982441908 D |

where, as above, GMST must be reduced to the range 0h to 24h. The equations for GMST  
given above are adapted from those given in Appendix A of *USNO Circular No. 163* (1981).  
Here is another formula:  
L'Union Astronomique Internationale a défini la valeur du Temps Sidéral *Moyen* au  
méridien de Greenwich **à 00h UT** d'un jour donné par la formule suivante :

|  |
| --- |
| **GTSM0 = 6h 41m 50,54841s + 8640184s,812866 T + 0 s,093104 T2 - 0 s,0000062 T3** |

où T s'exprime par :  
T = ( J J - 2451545,0) / 36525  
Le Jour Julien pour ce jour à 00h se calcule par les formules données ailleurs.  
Si vous préférez les degrés l'expression devient :

|  |
| --- |
| **GTSM0 (°) = 100,46061837 + 36000,770053608 T + 0,000387933 T2 - T3 / 38710000** |

**Longitude**The longitude is measured eastward, so negative longitude means "west" (counterclockwise  
around Earth axis).  
**Azimuth**Azimuth is measured from south toward west (clockwise around the vertical axis).  
The direction of a bar antenna is given by its axis, the direction of an interferometer is that  
of the “first clockwise” arm, i.e. on the right, looking in the direction of the right angle  
bisectrix (N in Virgo).  
**Polarization angle**Defined respect the horizontal anticlockwise