# DynNestSapl\_metsim

It reads automatically EMCCD and CAMO all .pickle data that finds and combine EMCCD luminosity and CAMO deceleration if present for the one that share the same time (creates an folders and file called \_combined), they are all going to be save in a separate folder for the given event if an output folder is provided, if the output folder is not provided the run will be saved where the pickle files where found. The code will continue for all the solutions if one run does not work it will save the error message in the log\_ file and continue to the next. The motto is “**RUN IT AND FORGET ABOUT IT**" because it is going to take a while to get any results (1 to 2 days with 96 cores and in rare occasion 6 days, either a bright fireball or bad data). If for some reason the simulations was interrupted the code will continue on with the same .dynesty file without overwriting, you can do that by simply running again the same command mak sure to keep the .dynesty in the output folder).

**python "WMPG-repoMAX\Code\DynNestSampl\DynNestSapl\_metsim.py" "C:\Users\maxiv\Documents\INPUT-FOLDER" --output\_dir "C:\Users\maxiv\Desktop\OUTPUT-FOLDER" --prior "C:\Users\maxiv\WMPG-repoMAX\Code\DynNestSampl\stony\_meteoroid.prior"**

If you want to check at which stage is your result you can generate a plot with what is present in the .dynesty file thus far (doing so it will not overrite or change any of the file in the input folder, except for the log\_ file, it will just generate all the images) :

python "WMPG-repoMAX\Code\DynNestSampl\DynNestSapl\_metsim.py" "C:\Users\maxiv\Documents\INPUT-FOLDER" **-plot**

It can also work with MetSim json data if path and file name are in the input directory, it will introduced a set noise as given in the prior file (you can generate a new distribution of noise by running it again). If it has already been introduced before it will generate the same name json file and add \_with\_noise and you can load that from now on so it will keep the same datapoints.

python "WMPG-repoMAX\Code\DynNestSampl\DynNestSapl\_metsim.py" "C:\Users\maxiv\Documents\INPUT-FOLDER\**meteor\_metsim.json**" --output\_dir "C:\Users\maxiv\Desktop\OUTPUT-FOLDER" --prior "C:\Users\maxiv\WMPG-repoMAX\Code\DynNestSampl\stony\_meteoroid.prior"

You can process specific files or folders by separating them via a ',' comma.

python "WMPG-repoMAX\Code\DynNestSampl\DynNestSapl\_metsim.py" "C:\Users\maxiv\Documents\INPUT-FOLDER**, C:\Users\maxiv\Documents\INPUT-FOLDER\_2**" --output\_dir "C:\Users\maxiv\Desktop\OUTPUT-FOLDER" --prior "C:\Users\maxiv\WMPG-repoMAX\Code\DynNestSampl\stony\_meteoroid.prior"

If you do not specify the ouput folder it will use the folder where it found the pickle file, and if you do not specify the priors it will look for it in the folder where it found the pickle file if it does not find it will use the default value with a single fragmentation

python "WMPG-repoMAX\Code\DynNestSampl\DynNestSapl\_metsim.py" "C:\Users\maxiv\Documents\INPUT-FOLDER"

if you want to change the prior you can do so by editing the .prior file, anything after a # is not going to be read by the code:

# Each line represents a (min, max) tuple

# you can input expression and numpy functions (e.g. np.pi)

# without options it consider by default a uniform distribution with min and max value

# options:

# - nan : set it to default values or estimate the most likely for v\_init,zenith\_angle,m\_init,erosion\_height\_start (default norm sigma only for v\_init 500 and zenith\_angle 0.01)

# - norm : considers instead of uniform distribution a normal distribution and substitutes min and max with mean and sigma, good for velocity or zenith angle

# - invgamma: considers instead of uniform distribution a inverse gamma distribution that peak around the mode and have a long trail so it substitutes min and max with alpha and mode, good for noise uncertanty

# - log : cosider the log10 of the range given consider it for priors that extend for multiple order of magnitude (if 0.0 is set to 1e-12)

# - fix : fix the value to the first value given so it is not estimated by dynesty, the assumend noise in lag (noise\_lag) for EMCCD is 40 m and CAMO is 5 m while for both in luminosity (noise\_lum) is 2.5 J/s

# what is writen after '#' is ignored

# name var, min/sigma/alpha, max/mean/mode, options

v\_init,500,nan,norm # v\_init [m/s] (gausian distribution)

zenith\_angle,nan,fix # zenith\_angle [rad] (fix by default)

m\_init,nan,nan # m\_init [kg]

rho,10,4000,log # rho [kg/m^3] (np.log10 applied)

sigma,0.001/1e6,0.05/1e6 # sigma [kg/J]

erosion\_height\_start,nan,nan # erosion\_height\_start [m]

erosion\_coeff,0.0,1e-6,log # erosion\_coeff [kg/J] (np.log10 applied)

erosion\_mass\_index,1,3 # erosion\_mass\_index [-]

erosion\_mass\_min,5e-12,1e-9,log # erosion\_mass\_min [kg] (np.log10 applied)

erosion\_mass\_max,1e-10,1e-7,log # erosion\_mass\_max [kg] (np.log10 applied)

erosion\_height\_change,nan,nan # erosion\_height\_change [m]

erosion\_rho\_change,10,4000,log # erosion\_rho\_change [kg/m^3] (np.log10 applied)

erosion\_sigma\_change,0.001/1e6,0.05/1e6 # erosion\_sigma\_change [kg/J]

erosion\_coeff\_change,0.0,1e-6,log # erosion\_coeff\_change [kg/J] (np.log10 applied)

noise\_lag,10,nan,invgamma # noise\_lag [m] (inverse gamma distribution)

noise\_lum,5,nan,invgamma # noise\_lum [J/s] (inverse gamma distribution)

If you do not want a double fragmentation you can simply delete that from the prior file and add the second fragmentation altitude in the code will be put at 1 km (i.e. inactive)

If you want to fix the noise delete the noise from the list and it will be considered fix (better not though)

If your camera in the pickle file is not an EMCCD or a CAMO widefield or narrow field, you can specify the zero magnitude power (P\_0m) an the fps of it by fixing it in the prior file.

P\_0m,840,fix

fps,20,fix

At the beginning it will create an output folder where it will copy the input pickle file, the prior file and the .txt report form the trajectory solution used to defined the specific meteor shower. Right after it will generate a log\_ file will be generated with the range of priors that the code will work with (i.e. log\_20191023\_084916\_combined.txt) and will generate an initial image to show how the data look like. This will be later populated again with the rest of the results or in case it crashed it will write the error message without breaking the code.

## Advance

If you more flexibility to your simulations you can add more variables to tune with the .extraprior file, they contain dust release, more erosion heights and specific change on the main fragment characteristics. These parameters are especially important for fireballs. Consider that above 30 variables to tune dynesty will have an hard time finding a good solution so do not put to many in!

python "WMPG-repoMAX\Code\DynNestSampl\DynNestSapl\_metsim.py" "C:\Users\maxiv\Documents\INPUT-FOLDER,WMPG-repoMAX\Code\DynNestSampl\DynNestSapl\_metsim.py" "C:\Users\maxiv\Documents\INPUT-FOLDER" --output\_dir "C:\Users\maxiv\Desktop\OUTPUT-FOLDER" --prior "C:\Users\maxiv\WMPG-repoMAX\Code\DynNestSampl\ stony\_meteoroid\_2frag.prior" **--extraprior "C:\Users\maxiv\WMPG-repoMAX\Code\DynNestSampl\ metsim\_fragmentation.extraprior"**

If need be you can run a new simulations in the same output folder by mentioning -new so it will not mix things up if you have two dynasty file in the same folder but if there are two dynasty file and you want to continue a simulation it will pick the first one (strongly recommend to use two separate folder for each)

python "WMPG-repoMAX\Code\DynNestSampl\DynNestSapl\_metsim.py" "C:\Users\maxiv\Documents\INPUT-FOLDER,WMPG-repoMAX\Code\DynNestSampl\DynNestSapl\_metsim.py" "C:\Users\maxiv\Documents\INPUT-FOLDER" --output\_dir "C:\Users\maxiv\Desktop\OUTPUT-FOLDER" --prior "C:\Users\maxiv\WMPG-repoMAX\Code\DynNestSampl\ stony\_meteoroid\_2frag.prior" **-new**

If you want to use all the data available you can do so by adding -all but make sure the magnitude are overlapping and the declaration are all computed from the same pickle file or different reference lag will be on top of each other (i.e. run wmpl.Formats.ECSV.py with all the .ecsv files so that you have a .pickle file with the solution with all the camera data combined correctly).

python "WMPG-repoMAX\Code\DynNestSampl\DynNestSapl\_metsim.py" "C:\Users\maxiv\Documents\INPUT-FOLDER,WMPG-repoMAX\Code\DynNestSampl\DynNestSapl\_metsim.py" "C:\Users\maxiv\Documents\INPUT-FOLDER" --output\_dir "C:\Users\maxiv\Desktop\OUTPUT-FOLDER" --prior "C:\Users\maxiv\WMPG-repoMAX\Code\DynNestSampl\ stony\_meteoroid\_2frag.prior" **-all**

If you did not pick the leading edge you can correct that by defining were you pick. For pick position in the meteor frame ranging from 0 to 1, for leading edge picks is 0 for the centroid on the entire meteor is 0.5 (centroid picks are mainly valid for fireball data) :

python "WMPG-repoMAX\Code\DynNestSampl\DynNestSapl\_metsim.py" "C:\Users\maxiv\Documents\INPUT-FOLDER,WMPG-repoMAX\Code\DynNestSampl\DynNestSapl\_metsim.py" "C:\Users\maxiv\Documents\INPUT-FOLDER" --output\_dir "C:\Users\maxiv\Desktop\OUTPUT-FOLDER" --prior "C:\Users\maxiv\WMPG-repoMAX\Code\DynNestSampl\ stony\_meteoroid\_2frag.prior" **--pick\_pos 0.5**

You can specify the number of cores that the code will use by mentioning the precise number if not specify it is going to use all of them (maybe useful if you still wanna open 200 tabs on your browser while waiting for the run to finish):

python "WMPG-repoMAX\Code\DynNestSampl\DynNestSapl\_metsim.py" "C:\Users\maxiv\Documents\INPUT-FOLDER,WMPG-repoMAX\Code\DynNestSampl\DynNestSapl\_metsim.py" "C:\Users\maxiv\Documents\INPUT-FOLDER" --output\_dir "C:\Users\maxiv\Desktop\OUTPUT-FOLDER" --prior "C:\Users\maxiv\WMPG-repoMAX\Code\DynNestSampl\ stony\_meteoroid\_2frag.prior" **–-cores 7**