Remote_control Stellarium V2

October 2, 2022

Código para importar "request" paquete utilizado para la comunicación con APIs

```
[1]: import requests
```

```
[2]: import json
     import numpy as np
     import sympy as sp
     import pandas as pd
     import math as mth
     import time
     from decimal import Decimal
     import matplotlib.pyplot as plt
     import datetime
     import jdcal as j
```

```
[3]: url_main = "http://localhost:8090/api/" #url para conexión con Stellarium, se␣
      ↪debe verificar en la conexión API
```

```
[4]: url_status = "main/status"
```

Se traen los datos de configuración actual, se extraen los requeridos como ubicación y tiempo

```
[5]: response_status = requests.get(url_main+url_status)
     print("Conexion con el servido principal: ", response_status.status_code)
     response_status.json()
```

```
Conexion con el servido principal:  200
```

```
[5]: {'location': {'altitude': 993,
       'landscapeKey': '',
       'latitude': 7.12539005279541,
       'longitude': -73.11979675292969,
       'name': 'Bucaramanga',
       'planet': 'Earth',
       'region': 'Southern America',
       'role': 'R',
       'state': 'Santander'},
      'selectioninfo': '',
 'time': {'deltaT': 0.0008002476446557006,
  'gmtShift': -0.20833333333333334,
  'isTimeNow': True,
  'jday': 2459834.736770116,
  'local': '2022-09-12T00:40:56.938',
  'timeZone': 'UTC-05:00',
  'timerate': 1.157407407407407e-05,
  'utc': '2022-09-12T05:40:56.938Z'},
 'view': {'fov': 42.991878634427316}}
```

[6]:

```python
json_status = response_status.json()
phi = json_status["location"]["latitude"]
time_var = json_status["time"]["jday"]
# print("Data setup: " , json_status)
```

Se Estipula el día y la fecha

[7]:

```python
#print("Ingrese la fecha en el formato AA-M-DTH:M:S")
#Date_time = str(input())
Date_time = "2021-12-26T18:30:00"
Date_time =time.strptime(Date_time,"%Y-%m-%dT%H:%M:%S")
Julian_date = sum(j.gcal2jd(Date_time.tm_year,Date_time.tm_mon,Date_time.
 ↪tm_mday))+0.5
Julian_date_dec = (((Date_time.tm_hour-7)*3600)+(Date_time.
 ↪tm_min*60)+(Date_time.tm_sec))*(1/86400)
Julian_date = Julian_date + Julian_date_dec
print(Julian_date)
url_time ="main/time"
params_time ={"time": Julian_date}
response_time = requests.post(url_main + url_time, data = params_time)
```

```
2459575.4791666665
```

Se realiza el tracking del objeto puesto en la variable target

[8]:

```python
url_obj_focus = "main/focus"
#En target poner la estrella o astro que se quiere seguir puede ser cualquiera␣
 ↪de la lista
#Yildun,Circitores, Alahakan, Alfirk, Alderamín, HIP 62046, Eltanin, Vega,␣
 ↪Sadir, Sulafat, Albireo, Sualocin
#Kornephoros, Rosalhague, Altair, Miaplacidus, Mimosa, Muhlifain, Menkent, Spica
target = "Sadalmelik"
params_focus={"target":target}
#Se pone en enfoque el objeto celeste deseado
response_focus = requests.post(url_main + url_obj_focus, data = params_focus)
response_focus.status_code
```

[8]:

```
200
```

[9]:

```
#El script a ejecutar es angulos_star.ssc
# Para poder correr el script, el script debe estar en la carpeta scripts de la␣
 ↪carpeta de instalación de stellarium
# esta se puede encontrar abriendo la ubicacion del archivo del ejecutable que␣
 ↪se instala

#El objetivo de este script es simplemente seguir el objetivo que se enfoco a␣
 ↪lo largo de la noche con un tiempo acelerado
url_script_info = "scripts/info"
params_info = {"id" : "angulos_star.ssc"}
script_info = requests.get(url_main +url_script_info,data = params_info)
json_scrp_info = script_info.json()
print("informacion del script: " ,json_scrp_info)
```

```
informacion del script:  {'author': 'David Becerra. 09/09/2021', 'description':
'', 'description_localized': '', 'id': 'angulos_star.ssc', 'license': 'Public
Domain', 'name': 'Motion of a specific Star', 'name_localized': 'Motion of a
specific Star', 'version': ''}
```

[10]:

```
#Se pone en ejecución el script
url_script = "scripts/run"
params_run ={"id" :"angulos_star.ssc"}
script_run = requests.post(url_main + url_script, data = params_run)

#se lee el status del script
url_scrun_info ="scripts/status"
script_runinfo = requests.get(url_main + url_scrun_info)
json_scrun_info = script_runinfo.json()
status_script = json_scrun_info["scriptIsRunning"]
azimut = []
altitud = []
tiempo = []
tiempo_jd =[]
tiempo_str =[]
```

[11]:

```
while status_script:
    ##Apunta al objeto
    response_focus_script = requests.post(url_main + url_obj_focus, data =␣
 ↪params_focus)
    ##Informacion del objeto
    url_obj_info = "objects/info"
    params_obj_info = {"name" : target, "format" : "json"}
    response_obj = requests.get(url_main + url_obj_info, data = params_obj_info)
    #print("Status informacion objeto: ", response_obj.status_code)
    json_objinfo = response_obj.json()
    azimuth = json_objinfo["azimuth"]
    altitude = json_objinfo["altitude"]
    #print("Azimuth: ", azimuth)
    #print("Altitud: ", altitude)
    azimut.append(azimuth)
    altitud.append(altitude)
    #print("status del script: ",status_script )
    ##Obtiene el tiempo en JS
    response_status = requests.get(url_main+url_status)
    json_status = response_status.json()
    time_var = json_status["time"]["jday"]
    time_var_utc = json_status["time"]["local"]
    time_pract = time_var_utc
    time_var_utc =time.strptime(time_var_utc,"%Y-%m-%dT%H:%M:%S.%f")

    #print("tiempo en JD: ", time_var, ",", type(time_var))
    #print("Time en UTC", time_var_utc, ",", type(time_var_utc))
    tiempo.append(time_var_utc)
    tiempo_jd.append(time_var)
    tiempo_str.append(time_pract)
    ##Revisa si el script se está ejecutando
    script_runinfo = requests.get(url_main + url_scrun_info)
    json_scrun_info = script_runinfo.json()
    status_script = json_scrun_info["scriptIsRunning"]
    time.sleep(0.0002)
    if (time_var_utc.tm_mday > 10 & time_var_utc.tm_hour > 18):
        status_script = False
```

Se calcula los vectores de velocidad

[12]:

```
#Se crean las nuevas listas que almacenarán los datos
delta_azimut = []
delta_tim_sec = []
rpm_azimut = []
vel_azimut =[]

delta_ele = []
vel_ele =[]
rpm_ele = []

date_calc = []
```

[13]:

```
#Funciones para saber si el azimut está en el primero o cuarto cuadrante
def flag_az_4(var_flag):
    flag_az = bool(270<=var_flag<=360)
    return flag_az
def flag_az_1(var_flag):
    flag_az = bool(0<=var_flag<=90)
    return flag_az
```

[14]:

```
#Calcula las velocidades de azimut, altitud y le da el tiempo
for i in range(len(azimut)-1):
    #Si el azimut pasa del primer al cuarto cuadrante
    if flag_az_4(azimut[i+1])&flag_az_1(azimut[i]):
        azimut_mod = azimut[i+1] - 360
        delta_azimut.append(azimut_mod -azimut[i])
        delta_azimut[i] = abs(delta_azimut[i])
        #print("este es el azimut inicial: ",azimut[i])
        #print("este es el azimut final: ", azimut[i+1])
        #print("1-4",delta_azimut[i])
    #Si el azimut pasa del cuarto al primer cuadrante
    elif flag_az_1(azimut[i+1]) & flag_az_4(azimut[i]):
        azimut_mod =azimut[i]-360
        delta_azimut.append(azimut[i+1]-azimut_mod)
        delta_azimut[i] = abs(delta_azimut[i])
        #print("este es el azimut inicial: ",azimut[i])
        #print("este es el azimut final: ", azimut[i+1])
        #print("4-1",delta_azimut[i])
    #En cualquier otro caso
    else:
        delta_azimut.append(azimut[i+1]-azimut[i])
        delta_azimut[i] = abs(delta_azimut[i])
        #print("este es el azimut inicial: ",azimut[i])
        #print("este es el azimut final: ", azimut[i+1])
        #print("1-1 o 4-4", delta_azimut[i])
    #print(delta_azimut[i])
    #Calcula la diferencia de tiempo en segundos y lo añade a delta_tim_sec
    delta_tim_sec.append((tiempo_jd[i+1] - tiempo_jd[i])*86400)
    #Calculo de las velocidades azimutales
    rpm_azimut.append((delta_azimut[i]/delta_tim_sec[i])*(1/360)*(60))
    vel_azimut.append(delta_azimut[i]/delta_tim_sec[i])
    #Calculo de la velocidades de elevacion
    delta_ele.append((altitud[i-1]-altitud[i]))
    delta_ele[i]=abs(delta_ele[i])
    vel_ele.append(delta_ele[i]/delta_tim_sec[i])
    rpm_ele.append(vel_ele[i]*(1/360)*60)
    #Se da el valor de fecha
    date_calc.append(tiempo[i])

    #print("Cambio en la altitud: ", delta_ele[i])
    #print("La velocidad azimutal es: ", vel_azimut)
    #print("La velocidadazimutal  en revoluciones por minuto es: ",␣
↪rpm_azimut[i])
```

[15]:
```
#Solo toma las horas de los datos
Hora_data = []
for i in range(len(tiempo)):
    Hora_data.append(str(tiempo[i].tm_hour) +":" + str(tiempo[i].tm_min) + ":"+␣
↪str(tiempo[i].tm_sec))
Hora_vel = []
for i in range(len(date_calc)):
    Hora_vel.append(str(date_calc[i].tm_hour) +":" + str(date_calc[i].tm_min) +␣
↪":"+ str(date_calc[i].tm_sec))
```

[16]:
```
#azimut_pd = pd.Series(vel_azimut, index = date_calc)
#altitud_pd = pd.Series(vel_ele, index = date_calc)
Astronomic_data_vel = pd.DataFrame({"velocidad azimut":vel_azimut, "velocidad␣
↪altitud": vel_ele,"Date":date_calc, "Hora":Hora_vel})

#Datos de azimiut y elevación
AstroData = {"azimut": azimut, "elevacion": altitud, "Date":tiempo, "Hora":␣
↪Hora_data}
Astro_data = pd.DataFrame(AstroData)
pd.options.display.max_rows=None

#Datos de posiciones
print("Posiciones: ")
print(Astro_data)

#Datos de velocidades
print("Velocidades:")
print(Astronomic_data_vel)
```

```
Posiciones:
         azimut  elevacion                                     Date      Hora
0     71.807812 -68.830187    (2021, 6, 9, 18, 7, 30, 2, 160, -1)   18:7:30
1     73.511884 -66.935221   (2021, 6, 9, 18, 15, 28, 2, 160, -1)  18:15:28
2     74.980095 -65.010287   (2021, 6, 9, 18, 23, 31, 2, 160, -1)  18:23:31
3     76.241946 -63.087457   (2021, 6, 9, 18, 31, 30, 2, 160, -1)  18:31:30
4     77.351302 -61.147590   (2021, 6, 9, 18, 39, 32, 2, 160, -1)  18:39:32
5     78.445954 -58.958538   (2021, 6, 9, 18, 48, 28, 2, 160, -1)  18:48:28
6     79.309751 -57.003451   (2021, 6, 9, 18, 56, 29, 2, 160, -1)  18:56:29
7     80.084837 -55.050419    (2021, 6, 9, 19, 4, 30, 2, 160, -1)   19:4:30
```

```
8     80.790686 -53.085609   (2021, 6, 9, 19, 12, 30, 2, 160, -1)  19:12:30
9     81.435243 -51.117039   (2021, 6, 9, 19, 20, 29, 2, 160, -1)  19:20:29
10    82.061454 -49.027016    (2021, 6, 9, 19, 29, 0, 2, 160, -1)   19:29:0
11    82.604226 -47.059742   (2021, 6, 9, 19, 36, 59, 2, 160, -1)  19:36:59
12    83.110534 -45.082723    (2021, 6, 9, 19, 45, 0, 2, 160, -1)   19:45:0
13    83.581590 -43.111077   (2021, 6, 9, 19, 52, 58, 2, 160, -1)  19:52:58
14    84.025177 -41.130240    (2021, 6, 9, 20, 0, 59, 2, 160, -1)   20:0:59
15    84.467382 -39.029003   (2021, 6, 9, 20, 10, 28, 2, 160, -1)  20:10:28
16    84.957128 -36.547147   (2021, 6, 9, 20, 19, 30, 2, 160, -1)  20:19:30
17    85.371315 -34.316380   (2021, 6, 9, 20, 28, 30, 2, 160, -1)  20:28:30
18    85.768268 -32.062012    (2021, 6, 9, 20, 39, 0, 2, 160, -1)   20:39:0
19    86.161133 -29.717167    (2021, 6, 9, 20, 47, 2, 2, 160, -1)   20:47:2
20    86.477958 -27.743697    (2021, 6, 9, 20, 55, 1, 2, 160, -1)   20:55:1
21    86.788328 -25.739763     (2021, 6, 9, 21, 3, 0, 2, 160, -1)    21:3:0
22    87.084294 -23.765040    (2021, 6, 9, 21, 11, 0, 2, 160, -1)   21:11:0
23    87.373826 -21.774896    (2021, 6, 9, 21, 19, 1, 2, 160, -1)   21:19:1
24    87.654668 -19.791753    (2021, 6, 9, 21, 27, 0, 2, 160, -1)   21:27:0
25    87.946192 -17.681437   (2021, 6, 9, 21, 35, 29, 2, 160, -1)  21:35:29
26    88.216291 -15.682623    (2021, 6, 9, 21, 44, 0, 2, 160, -1)   21:44:0
27    88.479461 -13.698437   (2021, 6, 9, 21, 51, 59, 2, 160, -1)  21:51:59
28    88.723982 -11.825921    (2021, 6, 9, 21, 59, 0, 2, 160, -1)   21:59:0
29    88.978802  -9.848770     (2021, 6, 9, 22, 7, 1, 2, 160, -1)    22:7:1
30    89.232743  -7.856540    (2021, 6, 9, 22, 15, 0, 2, 160, -1)   22:15:0
31    89.484524  -5.864191    (2021, 6, 9, 22, 23, 0, 2, 160, -1)   22:23:0
32    89.734778  -3.626372    (2021, 6, 9, 22, 31, 1, 2, 160, -1)   22:31:1
33    89.999047  -1.029784   (2021, 6, 9, 22, 40, 30, 2, 160, -1)  22:40:30
34    90.342348   1.344791    (2021, 6, 9, 22, 51, 0, 2, 160, -1)   22:51:0
35    90.607936   3.325347    (2021, 6, 9, 22, 59, 0, 2, 160, -1)   22:59:0
36    90.856977   5.239893     (2021, 6, 9, 23, 7, 1, 2, 160, -1)    23:7:1
37    91.077409   6.945618   (2021, 6, 9, 23, 13, 58, 2, 160, -1)  23:13:58
38    91.332259   8.913034    (2021, 6, 9, 23, 22, 1, 2, 160, -1)   23:22:1
39    91.590142  10.888009    (2021, 6, 9, 23, 30, 0, 2, 160, -1)   23:30:0
40    91.851742  12.867361    (2021, 6, 9, 23, 38, 0, 2, 160, -1)   23:38:0
41    92.115770  14.834524   (2021, 6, 9, 23, 45, 59, 2, 160, -1)  23:45:59
42    92.387998  16.825621    (2021, 6, 9, 23, 54, 1, 2, 160, -1)   23:54:1
43    92.664192  18.802868     (2021, 6, 10, 0, 2, 0, 3, 161, -1)     0:2:0
44    92.948316  20.788122    (2021, 6, 10, 0, 10, 1, 3, 161, -1)    0:10:1
45    93.240305  22.773643    (2021, 6, 10, 0, 18, 0, 3, 161, -1)    0:18:0
46    93.540063  24.751738    (2021, 6, 10, 0, 26, 0, 3, 161, -1)    0:26:0
47    93.851001  26.737082    (2021, 6, 10, 0, 34, 1, 3, 161, -1)    0:34:1
48    94.173291  28.722061    (2021, 6, 10, 0, 42, 1, 3, 161, -1)    0:42:1
49    94.508365  30.706511    (2021, 6, 10, 0, 50, 0, 3, 161, -1)    0:50:0
50    94.856492  32.682846    (2021, 6, 10, 0, 57, 1, 3, 161, -1)    0:57:1
51    95.198300  34.539539    (2021, 6, 10, 1, 5, 31, 3, 161, -1)    1:5:31
52    95.532588  36.276615   (2021, 6, 10, 1, 12, 28, 3, 161, -1)   1:12:28
53    95.931477  38.250156   (2021, 6, 10, 1, 20, 31, 3, 161, -1)   1:20:31
54    96.380752  40.348347    (2021, 6, 10, 1, 29, 0, 3, 161, -1)    1:29:0
55    96.772426  42.074505    (2021, 6, 10, 1, 36, 0, 3, 161, -1)    1:36:0
```

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56   97.248676  44.050865   (2021, 6, 10, 1, 44, 0, 3, 161, -1)   1:44:0
57   97.724660  45.899506  (2021, 6, 10, 1, 51, 32, 3, 161, -1)  1:51:32
58   98.233766  47.746056   (2021, 6, 10, 1, 59, 2, 3, 161, -1)   1:59:2
59   98.817076  49.708138    (2021, 6, 10, 2, 7, 1, 3, 161, -1)    2:7:1
60   99.457336  51.689117   (2021, 6, 10, 2, 15, 1, 3, 161, -1)   2:15:1
61  100.056572  53.394592  (2021, 6, 10, 2, 22, 31, 3, 161, -1)  2:22:31
62  100.859407  55.477837  (2021, 6, 10, 2, 30, 32, 3, 161, -1)  2:30:32
63  101.692712  57.423752  (2021, 6, 10, 2, 38, 31, 3, 161, -1)  2:38:31
64  102.623645  59.370789  (2021, 6, 10, 2, 46, 30, 3, 161, -1)  2:46:30
65  103.668293  61.310360  (2021, 6, 10, 2, 54, 32, 3, 161, -1)  2:54:32
66  104.846251  63.233589   (2021, 6, 10, 3, 2, 31, 3, 161, -1)   3:2:31
67  106.203155  65.159973  (2021, 6, 10, 3, 10, 33, 3, 161, -1)  3:10:33
68  108.184450  67.526245   (2021, 6, 10, 3, 22, 3, 3, 161, -1)   3:22:3
69  111.040029  70.232407  (2021, 6, 10, 3, 32, 33, 3, 161, -1)  3:32:33
70  114.895504  72.967476   (2021, 6, 10, 3, 48, 1, 3, 161, -1)   3:48:1
71  120.713363  75.834709   (2021, 6, 10, 3, 58, 1, 3, 161, -1)   3:58:1
72  128.099481  78.202835   (2021, 6, 10, 4, 9, 30, 3, 161, -1)   4:9:30
73  138.250475  80.201546  (2021, 6, 10, 4, 19, 30, 3, 161, -1)  4:19:30
74  148.373448  81.396118  (2021, 6, 10, 4, 27, 32, 3, 161, -1)  4:27:32
75  161.985955  82.285332   (2021, 6, 10, 4, 36, 0, 3, 161, -1)   4:36:0
76  177.150688  82.650467   (2021, 6, 10, 4, 44, 2, 3, 161, -1)   4:44:2
77  192.653291  82.478722   (2021, 6, 10, 4, 52, 1, 3, 161, -1)   4:52:1
78  206.485901  81.809280    (2021, 6, 10, 5, 0, 1, 3, 161, -1)    5:0:1
79  217.748785  80.745293    (2021, 6, 10, 5, 8, 0, 3, 161, -1)    5:8:0
80  226.424827  79.411560   (2021, 6, 10, 5, 16, 1, 3, 161, -1)   5:16:1
81  233.456514  77.787048  (2021, 6, 10, 5, 24, 30, 3, 161, -1)  5:24:30
82  238.501853  76.140816  (2021, 6, 10, 5, 32, 31, 3, 161, -1)  5:32:31
83  242.484484  74.406349  (2021, 6, 10, 5, 40, 31, 3, 161, -1)  5:40:31
84  245.675464  72.614250  (2021, 6, 10, 5, 48, 32, 3, 161, -1)  5:48:32
85  248.280037  70.780655  (2021, 6, 10, 5, 56, 33, 3, 161, -1)  5:56:33
86  250.442564  68.916389   (2021, 6, 10, 6, 4, 31, 3, 161, -1)   6:4:31
87  252.259574  67.036049  (2021, 6, 10, 6, 12, 32, 3, 161, -1)  6:12:32
88  253.818984  65.130760  (2021, 6, 10, 6, 20, 31, 3, 161, -1)  6:20:31
89  255.163578  63.218609  (2021, 6, 10, 6, 28, 31, 3, 161, -1)  6:28:31
90  256.348652  61.280800  (2021, 6, 10, 6, 36, 30, 3, 161, -1)  6:36:30
91  257.380350  59.362946  (2021, 6, 10, 6, 44, 31, 3, 161, -1)  6:44:31
92  258.370006  57.284374  (2021, 6, 10, 6, 53, 31, 3, 161, -1)  6:53:31
93  259.247261  55.213493   (2021, 6, 10, 7, 1, 31, 3, 161, -1)   7:1:31
94  260.039764  53.129581   (2021, 6, 10, 7, 10, 4, 3, 161, -1)   7:10:4
95  260.755966  51.048244  (2021, 6, 10, 7, 18, 30, 3, 161, -1)  7:18:30
96  261.376775  49.073528   (2021, 6, 10, 7, 27, 1, 3, 161, -1)   7:27:1
97  262.045710  46.748619   (2021, 6, 10, 7, 36, 0, 3, 161, -1)   7:36:0
98  262.568588  44.775185  (2021, 6, 10, 7, 44, 31, 3, 161, -1)  7:44:31
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117	268.972032	6.563221	(2021, 6, 10, 10, 18, 30, 3, 161, -1)	10:18:30
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67    (2021, 6, 10, 3, 10, 33, 3, 161, -1)   3:10:33
68     (2021, 6, 10, 3, 22, 3, 3, 161, -1)    3:22:3
69    (2021, 6, 10, 3, 32, 33, 3, 161, -1)   3:32:33
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80     (2021, 6, 10, 5, 16, 1, 3, 161, -1)    5:16:1
81    (2021, 6, 10, 5, 24, 30, 3, 161, -1)   5:24:30
82    (2021, 6, 10, 5, 32, 31, 3, 161, -1)   5:32:31
83    (2021, 6, 10, 5, 40, 31, 3, 161, -1)   5:40:31
84    (2021, 6, 10, 5, 48, 32, 3, 161, -1)   5:48:32
85    (2021, 6, 10, 5, 56, 33, 3, 161, -1)   5:56:33
86     (2021, 6, 10, 6, 4, 31, 3, 161, -1)    6:4:31
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87    (2021, 6, 10, 6, 12, 32, 3, 161, -1)   6:12:32
88    (2021, 6, 10, 6, 20, 31, 3, 161, -1)   6:20:31
89    (2021, 6, 10, 6, 28, 31, 3, 161, -1)   6:28:31
90    (2021, 6, 10, 6, 36, 30, 3, 161, -1)   6:36:30
91    (2021, 6, 10, 6, 44, 31, 3, 161, -1)   6:44:31
92    (2021, 6, 10, 6, 53, 31, 3, 161, -1)   6:53:31
93     (2021, 6, 10, 7, 1, 31, 3, 161, -1)    7:1:31
94     (2021, 6, 10, 7, 10, 4, 3, 161, -1)    7:10:4
95    (2021, 6, 10, 7, 18, 30, 3, 161, -1)   7:18:30
96     (2021, 6, 10, 7, 27, 1, 3, 161, -1)    7:27:1
97     (2021, 6, 10, 7, 36, 0, 3, 161, -1)    7:36:0
98    (2021, 6, 10, 7, 44, 31, 3, 161, -1)   7:44:31
99    (2021, 6, 10, 7, 52, 31, 3, 161, -1)   7:52:31
100    (2021, 6, 10, 8, 0, 32, 3, 161, -1)    8:0:32
101     (2021, 6, 10, 8, 9, 1, 3, 161, -1)     8:9:1
102    (2021, 6, 10, 8, 17, 2, 3, 161, -1)    8:17:2
103    (2021, 6, 10, 8, 25, 3, 3, 161, -1)    8:25:3
104    (2021, 6, 10, 8, 33, 1, 3, 161, -1)    8:33:1
105   (2021, 6, 10, 8, 41, 31, 3, 161, -1)   8:41:31
106   (2021, 6, 10, 8, 49, 31, 3, 161, -1)   8:49:31
107    (2021, 6, 10, 8, 58, 1, 3, 161, -1)    8:58:1
108     (2021, 6, 10, 9, 6, 1, 3, 161, -1)     9:6:1
109   (2021, 6, 10, 9, 14, 31, 3, 161, -1)   9:14:31
110   (2021, 6, 10, 9, 22, 31, 3, 161, -1)   9:22:31
111   (2021, 6, 10, 9, 30, 30, 3, 161, -1)   9:30:30
112   (2021, 6, 10, 9, 38, 33, 3, 161, -1)   9:38:33
113   (2021, 6, 10, 9, 46, 31, 3, 161, -1)   9:46:31
114   (2021, 6, 10, 9, 54, 30, 3, 161, -1)   9:54:30
115   (2021, 6, 10, 10, 2, 31, 3, 161, -1)   10:2:31
116  (2021, 6, 10, 10, 10, 31, 3, 161, -1)  10:10:31
117  (2021, 6, 10, 10, 18, 30, 3, 161, -1)  10:18:30
118  (2021, 6, 10, 10, 26, 31, 3, 161, -1)  10:26:31
119  (2021, 6, 10, 10, 34, 33, 3, 161, -1)  10:34:33
120  (2021, 6, 10, 10, 42, 32, 3, 161, -1)  10:42:32
121  (2021, 6, 10, 10, 50, 31, 3, 161, -1)  10:50:31
122  (2021, 6, 10, 10, 58, 31, 3, 161, -1)  10:58:31
123   (2021, 6, 10, 11, 6, 32, 3, 161, -1)   11:6:32
124  (2021, 6, 10, 11, 14, 33, 3, 161, -1)  11:14:33
125  (2021, 6, 10, 11, 22, 33, 3, 161, -1)  11:22:33
126  (2021, 6, 10, 11, 30, 32, 3, 161, -1)  11:30:32
127  (2021, 6, 10, 11, 38, 33, 3, 161, -1)  11:38:33
128  (2021, 6, 10, 11, 46, 31, 3, 161, -1)  11:46:31
129  (2021, 6, 10, 11, 54, 32, 3, 161, -1)  11:54:32
130   (2021, 6, 10, 12, 2, 34, 3, 161, -1)   12:2:34
131  (2021, 6, 10, 12, 10, 33, 3, 161, -1)  12:10:33
132   (2021, 6, 10, 12, 19, 1, 3, 161, -1)   12:19:1
133   (2021, 6, 10, 12, 27, 1, 3, 161, -1)   12:27:1
134   (2021, 6, 10, 12, 35, 2, 3, 161, -1)   12:35:2
```

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135   (2021, 6, 10, 12, 43, 3, 3, 161, -1)   12:43:3
136   (2021, 6, 10, 12, 51, 1, 3, 161, -1)   12:51:1
137   (2021, 6, 10, 12, 59, 2, 3, 161, -1)   12:59:2
138   (2021, 6, 10, 13, 7, 31, 3, 161, -1)   13:7:31
139  (2021, 6, 10, 13, 15, 32, 3, 161, -1)  13:15:32
140  (2021, 6, 10, 13, 23, 31, 3, 161, -1)  13:23:31
141  (2021, 6, 10, 13, 31, 31, 3, 161, -1)  13:31:31
142   (2021, 6, 10, 13, 40, 1, 3, 161, -1)   13:40:1
143   (2021, 6, 10, 13, 48, 1, 3, 161, -1)   13:48:1
144   (2021, 6, 10, 13, 56, 2, 3, 161, -1)   13:56:2
145    (2021, 6, 10, 14, 4, 3, 3, 161, -1)    14:4:3
146   (2021, 6, 10, 14, 12, 1, 3, 161, -1)   14:12:1
147   (2021, 6, 10, 14, 20, 2, 3, 161, -1)   14:20:2
148   (2021, 6, 10, 14, 28, 3, 3, 161, -1)   14:28:3
149   (2021, 6, 10, 14, 36, 3, 3, 161, -1)   14:36:3
150   (2021, 6, 10, 14, 44, 2, 3, 161, -1)   14:44:2
151  (2021, 6, 10, 14, 52, 31, 3, 161, -1)  14:52:31
152   (2021, 6, 10, 15, 0, 34, 3, 161, -1)   15:0:34
153   (2021, 6, 10, 15, 8, 33, 3, 161, -1)   15:8:33
154  (2021, 6, 10, 15, 16, 31, 3, 161, -1)  15:16:31
155  (2021, 6, 10, 15, 24, 34, 3, 161, -1)  15:24:34
156  (2021, 6, 10, 15, 32, 33, 3, 161, -1)  15:32:33
157  (2021, 6, 10, 15, 40, 31, 3, 161, -1)  15:40:31
158  (2021, 6, 10, 15, 48, 34, 3, 161, -1)  15:48:34
159  (2021, 6, 10, 15, 56, 33, 3, 161, -1)  15:56:33
160   (2021, 6, 10, 16, 4, 33, 3, 161, -1)   16:4:33
161   (2021, 6, 10, 16, 13, 1, 3, 161, -1)   16:13:1
162   (2021, 6, 10, 16, 21, 3, 3, 161, -1)   16:21:3
163   (2021, 6, 10, 16, 29, 4, 3, 161, -1)   16:29:4
164   (2021, 6, 10, 16, 37, 4, 3, 161, -1)   16:37:4
165   (2021, 6, 10, 16, 45, 3, 3, 161, -1)   16:45:3
166   (2021, 6, 10, 16, 53, 6, 3, 161, -1)   16:53:6
167    (2021, 6, 10, 17, 1, 3, 3, 161, -1)    17:1:3
168    (2021, 6, 10, 17, 9, 1, 3, 161, -1)    17:9:1
169   (2021, 6, 10, 17, 17, 2, 3, 161, -1)   17:17:2
170  (2021, 6, 10, 17, 25, 31, 3, 161, -1)  17:25:31
171  (2021, 6, 10, 17, 33, 32, 3, 161, -1)  17:33:32
172  (2021, 6, 10, 17, 41, 31, 3, 161, -1)  17:41:31
173  (2021, 6, 10, 17, 49, 31, 3, 161, -1)  17:49:31
```
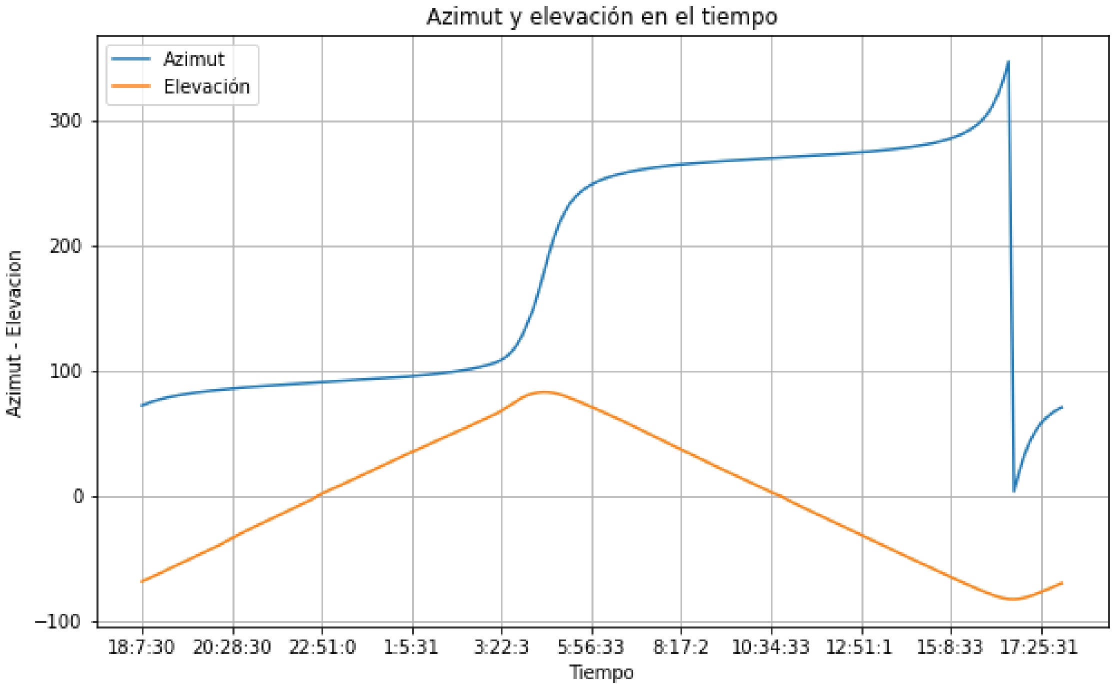
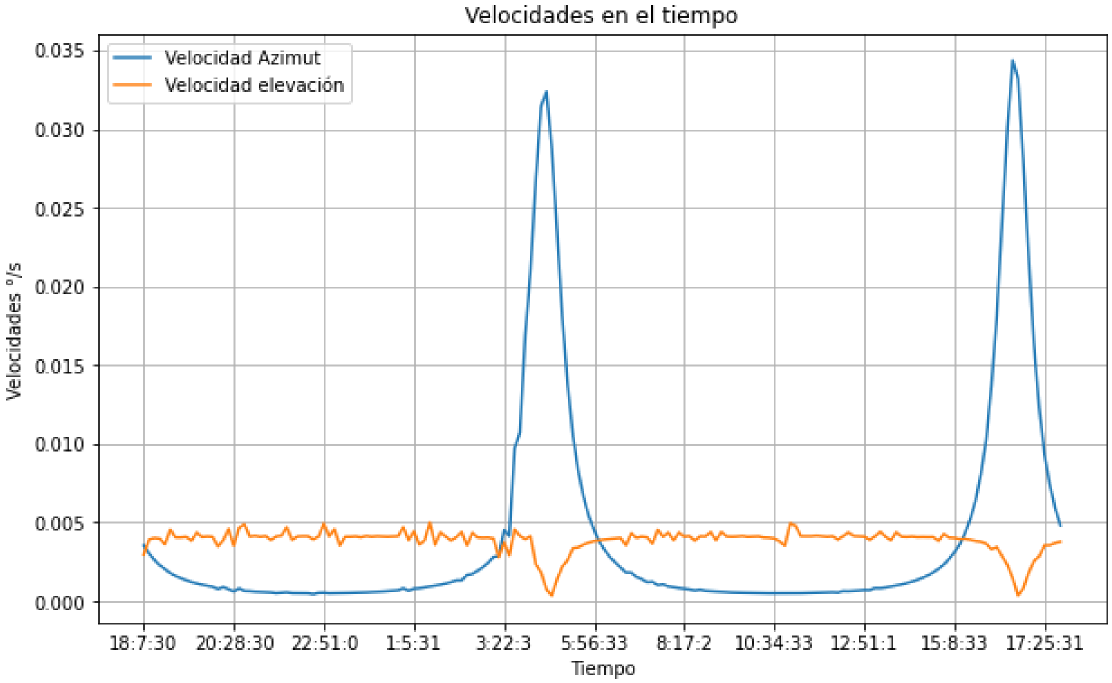

[17]:

```
#Grafica de posicion
xpos_stick = len(Astro_data["Hora"])
fig, ax = plt.subplots(figsize=(10,6))
azimut_plot = ax.plot(Astro_data["Hora"], Astro_data["azimut"],label="Azimut")
elevacion_plot = ax.plot(Astro_data["Hora"],␣
 ↪Astro_data["elevacion"],label="Elevación")
ax.set_ylabel("Azimut - Elevacion")
ax.set_xlabel("Tiempo")
ax.set_title("Azimut y elevación en el tiempo")
xpos_values = ax.get_xticks()
newx_pos_values = [xpos_values[i] for i in range(0,xpos_stick,xpos_stick//10)]
ax.set_xticks(newx_pos_values)
ax.legend()
ax.grid(b=True)

#Grafica de velocidad
xvel_stick = len(Astronomic_data_vel["Hora"])
fig_vel, ax_vel = plt.subplots(figsize=(10,6))
velazim_plot = ax_vel.
 ↪plot(Astronomic_data_vel["Hora"],Astronomic_data_vel["velocidad␣
 ↪azimut"],label="Velocidad Azimut")
velalt_plot = ax_vel.
 ↪plot(Astronomic_data_vel["Hora"],Astronomic_data_vel["velocidad␣
 ↪altitud"],label ="Velocidad elevación")
ax_vel.set_ylabel("Velocidades °/s")
ax_vel.set_xlabel("Tiempo")
ax_vel.set_title("Velocidades en el tiempo")
xvel_values = ax_vel.get_xticks()
newx_vel_values = [xvel_values[i] for i in range(0,(xvel_stick//2)*2,xvel_stick/
 ↪/10)]
ax_vel.set_xticks(newx_vel_values)
ax_vel.legend()
ax_vel.grid(b=True)
#Astronomic_data_vel.plot()
```





[18]:

```
#Valores promedio, máx y min de velocidad en el eje del azimut
Velocidades_azimut = [
    Astronomic_data_vel["velocidad azimut"].mean(),
    Astronomic_data_vel["velocidad azimut"].max(),
     Astronomic_data_vel["velocidad azimut"].min()
]
Velocidades_elevacion = [
    Astronomic_data_vel["velocidad altitud"].mean(),
    Astronomic_data_vel["velocidad altitud"].max(),
    Astronomic_data_vel["velocidad altitud"].min(),
]
print("Valores promedio, max y min de velocidad en el eje de azimut")
print(Velocidades_azimut)
print("Valores promedio, max y min de velocidad en el eje de elevacion")
print(Velocidades_elevacion)
```

```
Valores promedio, max y min de velocidad en el eje de azimut
[0.0041553673861102315, 0.03436274944721639, 0.00046460801127904143]
Valores promedio, max y min de velocidad en el eje de elevacion
[0.0038514867498842175, 0.005002837900087811, 0.00035735600770381195]
```

[19]:

```
#Se guardan los datos del seguimiento en un archivo .csv

#Datos de posición como vectores numpy
data_azim_csv = Astro_data["azimut"].to_numpy(copy = True)
data_elev_csv = Astro_data["elevacion"].to_numpy(copy= True)
data_date_csv = Astro_data["Date"].to_numpy(copy= True)
data_hour_csv = Astro_data["Hora"].to_numpy(copy= True)

#Datos de velocidad como vectores numpy
data_velazim_csv = Astronomic_data_vel["velocidad azimut"].to_numpy(copy = True)
data_velelev_csv = Astronomic_data_vel["velocidad altitud"].to_numpy(copy =␣
 ↪True)

data_csv = pd.DataFrame(list(
zip(
    data_date_csv,
    data_hour_csv,
    data_azim_csv,
    data_elev_csv,
    data_velazim_csv,
    data_velelev_csv,
)),
columns=[
    "Fecha",
    "Hora",
    "Azimut",
    "Elevación",
    "Velocidad Azimut",
    "Velocidad Elevación"
])
#Cambiar el data por el nombre de la estrella que se siguió

data_csv.to_csv('16_Sadalmelik.csv',sep = ',',index = False)
```