

ITC09 Fundamental Data Analysis in Lunar and Planetary Explorations

演習課題5

- ・ 配布したソースコードスケルトンの空白部を埋めて、 lunar_footprint.cを完成させよ
 - subpnt_c()とsincpt_c()はspkとckに当該時刻のデータが含まれていない場合、エラーを返す場合がある。 サンプル/課題3を参考にしてエラー処理を入れること
- ・ 本資料に例示されているプロットを作成せよ

<lunar_footprint.c の内容>

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include "SpiceUsr.h"

#define STRLEN 100

//Macro definitions for getfov_c
#define BCVLEN 5 //max number of FOV bound vectors
#define ROOM 10

int main(int argc, char *argv[]) {

    SpiceDouble    lat;
    SpiceDouble    lon;
    SpiceDouble    radius;

    SpiceDouble    phase, incidence, emission;

    SpiceDouble    xpoint[3];
    SpiceDouble    xsrfvec[3];
    SpiceDouble    subpoint[3];
    SpiceDouble    subsrfvec[3];

    SpiceDouble    et;
    SpiceDouble    start_et;
    SpiceDouble    trgepc;
    SpiceChar      utc[STRLEN];
    SpiceChar      trgutc[STRLEN];

    SpiceDouble    SC_pos_bd[3];
    SpiceDouble    lt_SC, lt_lunar;

    //getfov_c related variables
    SpiceChar      shape [STRLEN];
    SpiceChar      frame [STRLEN]; //name of frame that FOV/boresight are defined.
    SpiceDouble    bsight [3]; //boresight vector
    SpiceInt       n_bcv; //number of FOV bound vectors
    SpiceDouble    bounds [BCVLEN][3];
    SpiceBoolean    found;

    //Define start time
    SpiceChar      time[STRLEN]="2004-05-17T09:30:00";

    //instrument NAIF ID
    //AMICA (camera): -130102
    SpiceInt       instid = -130102;
```

```

if (argc < 2) {
    fprintf(stderr, "Usage: %s kernel ...\n", argv[0]);
    exit(-1);
}

//Read kernels
while (argc > 1) {
    furnsh_c (argv[1]);
    fprintf(stderr, "%s is loaded.\n", argv[1]);
    --argc;
    ++argv;
}

//obtaining instrument info
getfov_c ( instid, BCVLEN, STRLEN, STRLEN,
           shape, frame, bsight, &n_bcv, bounds );

//convert start time in UTC to et
str2et_c ( time, &start_et );

//Set error actions (see exercise 3)
erract_c("SET", STRLEN, "RETURN");
errdev_c("SET", STRLEN, "NULL");

//Compute from the start time for 2 hours with 10 sec interval
for(et=start_et; et< start_et+3600*2; et=et+10){

    //Output time in UTC
    et2utc_c(et, "ISOC", 0, STRLEN, utc);
    printf("%s\t", utc);

    //compute sub-S/C point in XYZ
    /* fill here below */
    subpnt_c("Intercept: ellipsoid", "MOON", et, "IAU_MOON", "LT+S", "HAYABUSA", subpoint, &trgepc,
    subsrvec);

    //Error handling for subpnt_c() (see exercise 3)
    if(failed_c()){
        found = SPICEFALSE;
        reset_c();
    }

    //convert sub-S/C point to lat/lon and print
    reclat_c(subpoint, &radius, &lon, &lat);
    lon *= dpr_c();
    if (lon < 0) {
        lon = 180 - lon;
    }
    lat *= dpr_c();
    printf ("%4.2f\t%4.2f\t", lat, lon);

    //compute a footprint of the instrument on the lunar surface
    sincpt_c("Ellipsoid", "MOON", et, "IAU_MOON", "LT+S", "HAYABUSA", frame, bsight, xpoint, &trgepc,
    xsrvec, &found);

    //Error handling for sincpt_c() (see exercise 3)
    if(failed_c()){
        found = SPICEFALSE;
        reset_c();
    }
}

```

```

//if found a footprint
if(found) {
    //print observation time in UTC
    et2utc_c ( trgepc, "ISOC", 0, STRLEN, trputc );
    printf("%s\t",trputc);

    //convert footprint location to lat/lon and print
    reclat_c(xpoint, &radius, &lon, &lat);
    lon *= dpr_c();
    if (lon < 0) {
        lon = 180 - lon;
    }
    lat *= dpr_c();
    printf ("%4.2f\t%4.2f\t", lat, lon);

    //compute illumination conditions and print
    ilumin_c("Ellipsoid", "MOON", et, "IAU_MOON", "LT+S", "HAYABUSA", xpoint, &trgepc, xsrfvec,
    &phase, &incidence, &emission);
    phase *= dpr_c();
    incidence *= dpr_c();
    emission *= dpr_c();
    printf ("%4.2f\t%4.2f\t%4.2f", phase, incidence, emission);

}
printf ("\n");
}
return 0;
}

```

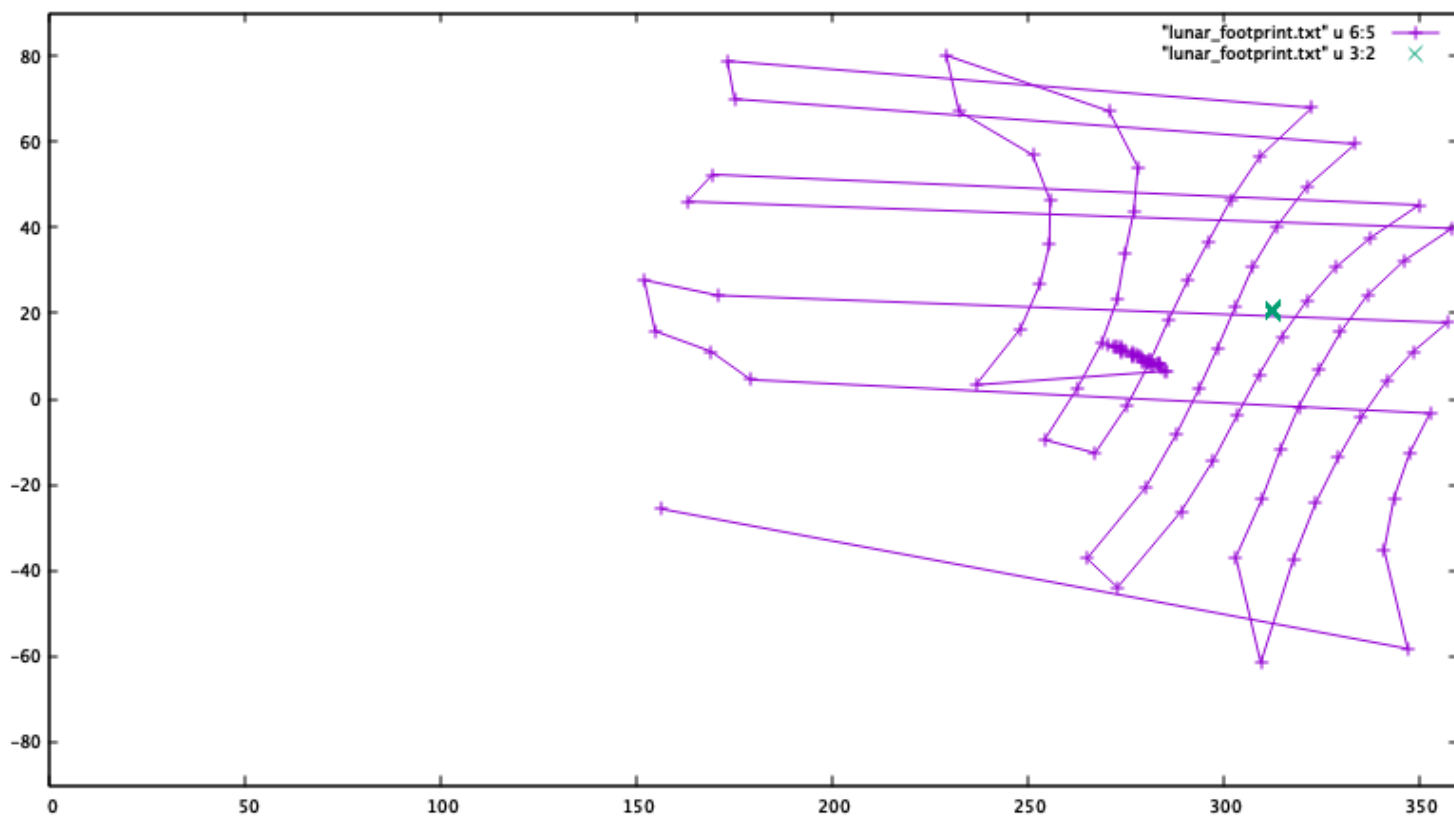
<得られた出力>

2004-05-17T09:30:00	20.15	312.82						
2004-05-17T09:30:10	20.16	312.82	2004-05-17T09:30:09	-25.61	156.36	30.30	52.84	82.85
2004-05-17T09:30:20	20.16	312.82						
2004-05-17T09:30:30	20.16	312.82						
2004-05-17T09:30:40	20.16	312.82						
2004-05-17T09:30:50	20.16	312.82						
2004-05-17T09:31:00	20.16	312.82						
2004-05-17T09:31:10	20.16	312.82						
2004-05-17T09:31:20	20.16	312.82						
2004-05-17T09:31:30	20.17	312.82						
2004-05-17T09:31:40	20.17	312.82						
2004-05-17T09:31:50	20.17	312.82						
2004-05-17T09:32:00	20.17	312.82						
2004-05-17T09:32:10	20.17	312.82						
2004-05-17T09:32:20	20.17	312.82						
2004-05-17T09:32:30	20.17	312.82						
2004-05-17T09:32:40	20.17	312.82						
2004-05-17T09:32:50	20.17	312.82						
2004-05-17T09:33:00	20.18	312.82						
2004-05-17T09:33:10	20.18	312.82						
2004-05-17T09:33:20	20.18	312.82						
2004-05-17T09:33:30	20.18	312.82						
2004-05-17T09:33:40	20.18	312.82						
2004-05-17T09:33:50	20.18	312.82						
2004-05-17T09:34:00	20.18	312.82						
2004-05-17T09:34:10	20.18	312.82						
2004-05-17T09:34:20	20.19	312.82						
2004-05-17T09:34:30	20.19	312.82						
2004-05-17T09:34:40	20.19	312.82						
2004-05-17T09:34:50	20.19	312.82						
2004-05-17T09:35:00	20.19	312.82						
2004-05-17T09:35:10	20.19	312.82						
2004-05-17T09:35:20	20.19	312.81						
2004-05-17T09:35:30	20.19	312.81	2004-05-17T09:35:29	-58.20	347.09	30.31	59.32	83.65
2004-05-17T09:35:40	20.20	312.81	2004-05-17T09:35:39	-35.18	341.08	30.31	35.95	61.77
2004-05-17T09:35:50	20.20	312.81	2004-05-17T09:35:49	-23.10	343.58	30.30	24.68	52.90
2004-05-17T09:36:00	20.20	312.81	2004-05-17T09:35:59	-12.70	347.51	30.30	17.40	47.61
2004-05-17T09:36:10	20.20	312.81	2004-05-17T09:36:09	-3.32	352.76	30.29	17.13	45.91
2004-05-17T09:36:20	20.20	312.81	2004-05-17T09:36:19	4.49	179.26	30.28	25.00	49.37
2004-05-17T09:36:30	20.20	312.81	2004-05-17T09:36:29	11.09	169.08	30.28	36.24	56.66
2004-05-17T09:36:40	20.20	312.81	2004-05-17T09:36:39	15.87	154.79	30.27	50.86	68.70
2004-05-17T09:36:50	20.20	312.81						

<gnuplotによるプロット>

- footprint位置の履歴

```
gnuplot> plot [0:360] [-90:90] "lunar_footprint.txt" u 6:5 with linespoints, "lunar_footprint.txt" u 3:2
```

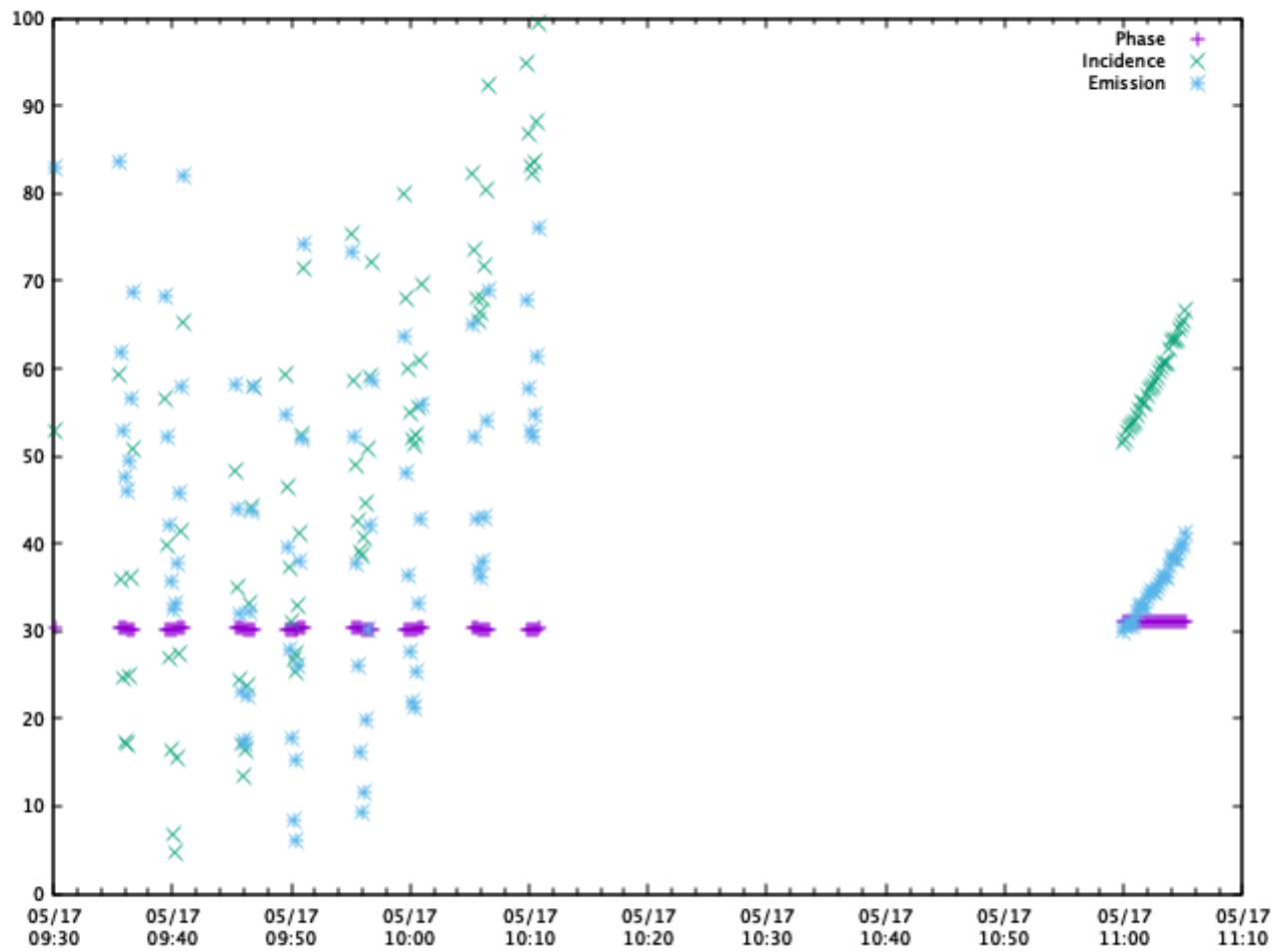


紫(u 6:5 - 視線位置の緯度と経度)

緑(u 3:2 - 直下点の緯度と経度)

- 日照条件の履歴

```
gnuplot> plot "lunar_footprint.txt" u 1:7 title "Phase", "lunar_footprint.txt" u 1:8 title "Incidence", "lunar_footprint.txt" u 1:9 title "Emission"
```



紫(位相角)

緑(入射角)

青(出射角)