우주궤도역학

TERM PROJECT #2

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Q. 주어진 궤도 정보로부터 주어진 날 자정부터 다음날 자정까지 하루 동안의 위치를 계산하여 Plot 수행

1. 주어진 정보를 loading 하는데 GPS, QZSS, BDS 중 선택
2. 관찰하고자 하는 시간을 설정
3. 관측자의 현재 위치(위도, 경도, 고도) 입력
4. Elevation angle의 cutoff 설정

```matlab
%% Loading Information
load('nav.mat')


%% INPUT (Satetllite)
disp("1)GPS 2)QZSS 3)BDS");
C = input("Choose from GPS, QZSS, or BDS which satellite information you want to receive ");

if C == 1
    a = nav.GPS.a*0.001;  % Semi-major axis(km)
    e = nav.GPS.e;  % Ecceinticity
    i = nav.GPS.i;  % Inclination(rad)
    RAAN = nav.GPS.OMEGA; % RAAN(rad)
    w = nav.GPS.omega; % Argument of perigee(rad)
    M0 = nav.GPS.M0; % Mean anomaly at toc(rad)
    toc = nav.GPS.toc; %toc
elseif C == 2
    a = nav.QZSS.a*0.001;  % Semi-major axis(km)
    e = nav.QZSS.e;  % Ecceinticity
    i = nav.QZSS.i;  % Inclination(rad)
    RAAN = nav.QZSS.OMEGA; % RAAN(rad)
    w = nav.QZSS.omega; % Argument of perigee(rad)
    M0 = nav.QZSS.M0; % Mean anomaly at toc(rad)
    toc = nav.QZSS.toc; %toc
elseif C == 3
    a = nav.BDS.a*0.001;  % Semi-major axis(km)
    e = nav.BDS.e;  % Ecceinticity
    i = nav.BDS.i;  % Inclination(rad)
    RAAN = nav.BDS.OMEGA; % RAAN(rad)
    w = nav.BDS.omega; % Argument of perigee(rad)
    M0 = nav.BDS.M0; % Mean anomaly at toc(rad)
    toc = nav.BDS.toc; %toc
end

```

```matlab
%% INPUT (Time)
disp('Enter the date to observe')
t = input("([YYYY,MM,DD,hh,mm,ss])format:");
Initial_time = datetime(t);
Final_time = datetime(t) + hours(24); % Observation time = 24hr
% Time set
t_toc = datetime(toc);
t_t = linspace(Initial_time, Final_time, 1440);

%% INPUT (Condition)
ground_lat = input('Enter lattitude of observation site (degree): ');
ground_lon = input('Enter longitude of observation site (degree): ');
height = input('Enter height of observation site (km): ');
el_mask = input('Enter elevation mask (degree): ');

```

5. 받은 입력값을 통해 궤도 계산 진행

① Orbital Elemets → PQW(Perifocal frame)
② PQW → ECI
③ ECI → ECEF → ECEF frame에서 geoplot을 위한 위성의 위도 경도 계산
④ ECEF → ENU → ENU frame에서 skyplot을 위한 Az,El 계산

Cf) 경과하는 시간에 따라 값을 받아야하므로 반복문 사용

```
        M = Mean(t_toc, t_t(k), a, M0);
        E = M2E(M, e);
        v = E2v(E, e);

        %% PQW
        R_PQW = solveRangeInPerifocalFrame(a, e, v);
        V_PQW = solveVelocityInPerifocalFrame(a, e, v);

        %% PQW -> ECI
        DCM_P_E = PQW2ECI(w, i, RAAN);
        R_ECI = DCM_P_E * R_PQW;
        V_ECI = DCM_P_E * V_PQW;

        %% ECI -> ECEF
        DCM_E_E = ECI2ECEF(t_t(k));
        R_ECEF = DCM_E_E * R_ECI;
        V_ECEF = DCM_E_E * V_ECI;

        %% ECEF -> Geodetic
        wgs84 = wgs84Ellipsoid('kilometer');
        [lat, lon, h] = ecef2geodetic(wgs84, R_ECEF(1), R_ECEF(2), R_ECEF(3), "degrees");
        lat_geoplot = [lat_geoplot, lat];
        lon_geoplot = [lon_geoplot, lon];

        %% ECEF -> ENU
        [R_ENU(1), R_ENU(2), R_ENU(3)] = ecef2enu(R_ECEF(1), R_ECEF(2), R_ECEF(3), ground_lat, ground_lon, height, wgs84);
        R_ENU = [R_ENU(1); R_ENU(2); R_ENU(3)];

        % Azimuth angle, Elevation angle
        az = azimuth1(R_ENU);
        el = elevation1(R_ENU, el_mask);
        az_skyplot = [az_skyplot, az];
        el_skyplot = [el_skyplot, el];
    end
```

6. Geoplot, Skyplot, Ground track

관측자 위도 : 37(deg), 경도 : 127(deg) 고도: 500(km)

Elevation Cutoff : 10(deg)

관측시간 : 86400(s) =24시간   관측날짜 : 2023.06.22.00.00

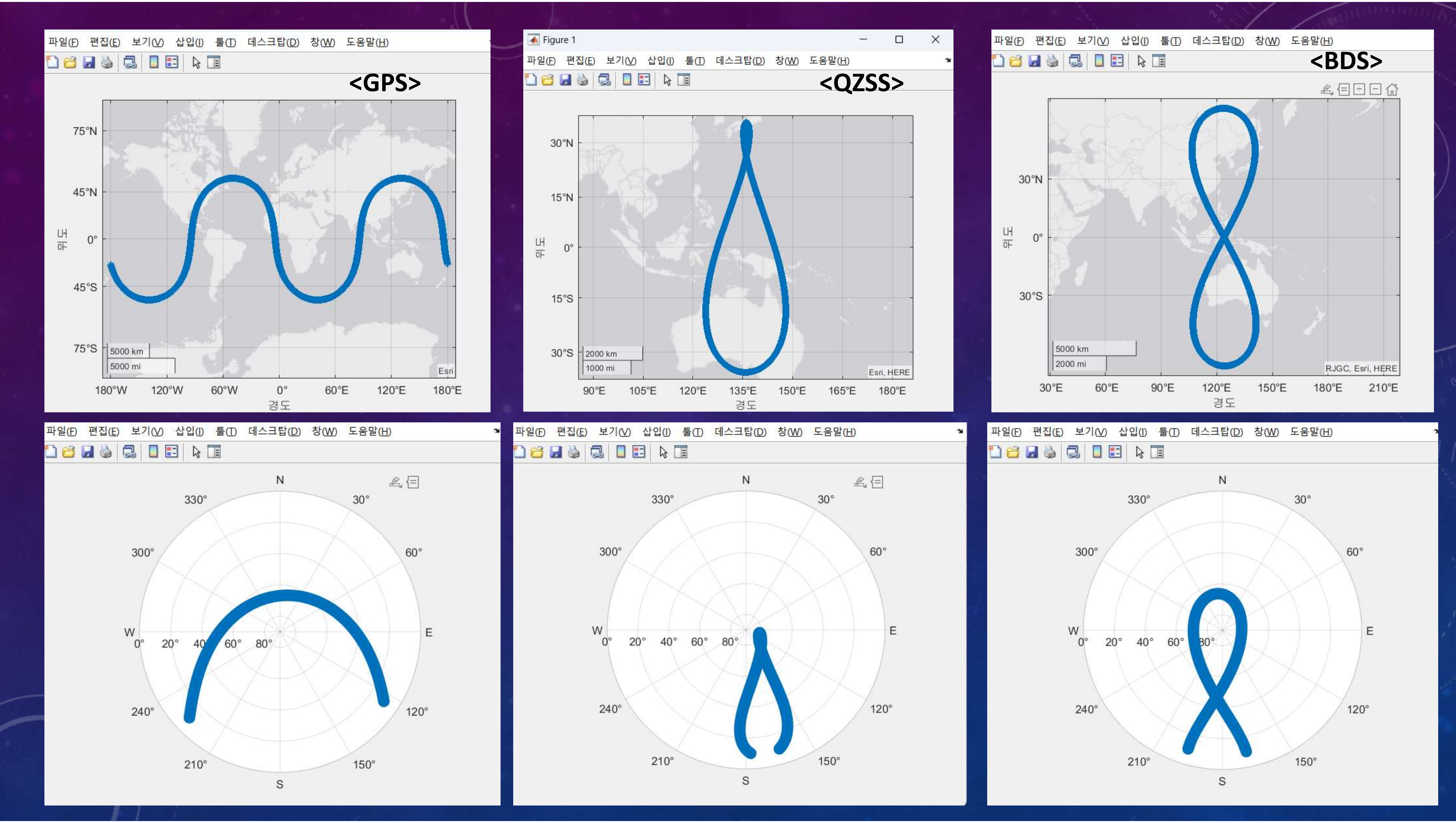
GPS = 1, QZSS = 2, BDS =3

```
1)GPS 2)QZSS 3)BDS
Choose from GPS, QZSS, or BDS which satellite information you want to receive 1
Enter the date to observe
([YYYY,MM,DD,hh,mm,ss])format:[2023,06,22,00,00,00]
Enter lattitude of observation site (degree): 37
Enter longitude of observation site (degree): 127
Enter height of observation site (km): 500
Enter elevation mask (degree): 10
```

```
%% Geoplot / Skyplot
geoplot(lat_geoplot, lon_geoplot,'*');
figure;
skyplot(az_skyplot, el_skyplot);

%% Simulation(GroundTrack)
sampleTime = 60;
sc = satelliteScenario(Initial_time,Final_time,sampleTime);
simul = satellite(sc,a*1000,e,i,RAAN,w,v);
show(simul)
groundTrack(simul,LeadTime=3600)
play(sc,PlaybackSpeedMultiplier=100)

```


<GPS>
<QZSS>
<BDS>
75°N
45°N
0°
45°S
75°S
180°W
120°W
60°W
0°
60°E
120°E
180°E
경도
위도
5000 km
5000 mi
Esri
30°N
15°N
15°S
30°S
90°E
105°E
120°E
135°E
150°E
165°E
180°E
2000 km
1000 mi
Esri, HERE
30°E
60°E
90°E
120°E
150°E
180°E
210°E
RJGC, Esri, HERE
N
S
E
W
330°
30°
300°
60°
240°
120°
210°
150°
0°
20°
40°
60°
80°

* Trimble gnss planning에서 받아온 실제결과