HOWTO g07: Stop the rotation to get gravitational quantities

You will learn how to stop the Earth's rotation in order to compute, for instance, the *gravitational* vector instead of the *gravity* vector (no centrifugal force).

All the GrafLab input parameters are explained in ../docs/graflab.md.

```
clear; clc; init_checker();
```

Synthesis of the gravitational vector (no centrifugal force)

At first, let's do the synthesis of the gravitational vector in *spherical* coordinates ("crd = 1").

To stop the Earth's rotation, you have to set the angular velocity of the ellipsoid to zero (see the "ellipsoid" variable in ../docs/graflab.md). This is because, GGMs do not have their own value of the angular velocity, so it is usually taken from the definition parameters of the reference ellipsoid. In fact, all elements of the "ellipsoid" array can safely be set to zero as long as you work with spherical coordinates of evaluation points.

Define the GrafLab input parameters

```
GM                = 3986004.415E+8;
R                 = 6378136.3;
nmin              = 0;
nmax              = 360;
ellipsoid         = [0.0 0.0 0.0 0.0 0.0];  % Make all parameters of the
                                            % reference ellipsoid zero.
GGM_path          = '../data/input/EGM96.mat';
crd               = 1;  % Spherical coordinates
point_type        = 0;
lat_grd_min       = -90.0;
lat_grd_step      =   1.0;
lat_grd_max       =  90.0;
lon_grd_min       =   0.0;
lon_grd_step      = lat_grd_step;
lon_grd_max       = 360.0;
h_grd             =   0.0;
out_path          = '../data/output/howto-g07-gravitational-vector-sph-crd';
quantity_or_error = 0;
quantity          = 16;  % Gravity vector; in this case, however,
                         % gravitational vector
fnALFs            = 1;
export_data_txt   = 1;
export_report     = 1;
export_data_mat   = 1;
display_data      = 2;
graphic_format    = 6;
colormap          = 1;
number_of_colors  = 60;
dpi               = 300;
status_bar        = 1;
```

Do the synthesis

```
GrafLab('OK', ...
    GM, ...
    R, ...
    nmin, ...
    nmax, ...
    ellipsoid, ...
    GGM_path, ...
    crd, ...
    point_type, ...
    lat_grd_min, ...
    lat_grd_step, ...
    lat_grd_max, ...
    lon_grd_min, ...
    lon_grd_step, ...
    lon_grd_max, ...
    h_grd, ...
    [], ...
    [], ...
    [], ...
    [], ...
    out_path, ...
    quantity_or_error, ...
    quantity, ...
    fnALFs, ...
    [], ...
    export_data_txt, ...
    export_report, ...
    export_data_mat, ...
    display_data, ...
    graphic_format, ...
    colormap, ...
    number_of_colors, ...
    dpi, ...
    status_bar);
```

Now, let's do the synthesis of the gravitational vector in *ellipsoidal* coordinates ("crd = 0").

Again, you have to set the angular velocity of the ellipsoid to zero. This time, however, two elements of the "ellipsoid" array are needed, the semimajor axis and the numerical eccentricity. This is because the ellipsoidal coordinates of the evaluation points have to be transformed into spherical coordinates. The latter coordinates are required for spherical harmonic synthesis. To do the coordinates transformation, you need set the semimajor axis and the numerical eccentricity to values of the ellipsoid you want to use (e.g., GRS80, WGS84 and so on).

Define the GrafLab input parameters.

```
GM                = 3986004.415E+8;
R                 = 6378136.3;
nmin              = 0;
nmax              = 360;
ellipsoid         = [0.0 6378137.0 sqrt(0.006694380022903416) 0.0 0.0];  % Note
                    % the semimajor axis of the numerical eccentricity of the
                    % reference ellipsoid.  Here, we are using GRS80.
```

```
GGM_path          = '../data/input/EGM96.mat';
crd               = 0;  % Ellipsoidal coordinates
point_type        = 0;
lat_grd_min       = -90.0;
lat_grd_step      =   1.0;
lat_grd_max       =  90.0;
lon_grd_min       =   0.0;
lon_grd_step      = lat_grd_step;
lon_grd_max       = 360.0;
h_grd             =   0.0;
out_path          = '../data/output/howto07-gravitational-vector-ell-crd';
quantity_or_error = 0;
quantity          = 16;  % Gravity vector; in this case, however,
                         % gravitational vector
fnALFs            = 1;
export_data_txt   = 1;
export_report     = 1;
export_data_mat   = 1;
display_data      = 2;
graphic_format    = 6;
colormap          = 1;
number_of_colors  = 60;
dpi               = 300;
status_bar        = 1;
```

Do the synthesis

```
GrafLab('OK', ...
    GM, ...
    R, ...
    nmin, ...
    nmax, ...
    ellipsoid, ...
    GGM_path, ...
    crd, ...
    point_type, ...
    lat_grd_min, ...
    lat_grd_step, ...
    lat_grd_max, ...
    lon_grd_min, ...
    lon_grd_step, ...
    lon_grd_max, ...
    h_grd, ...
    [], ...
    [], ...
    [], ...
    [], ...
    out_path, ...
    quantity_or_error, ...
    quantity, ...
    fnALFs, ...
    [], ...
    export_data_txt, ...
```

```
    export_report, ...
    export_data_mat, ...
    display_data, ...
    graphic_format, ...
    colormap, ...
    number_of_colors, ...
    dpi, ...
    status_bar);
```

The same comment as from the very end of HOWTO NO. 6 applies here, too.