Homework 8

2) load the attached GPS ice data from my deployment on the Ross Ice Shelf. The data (yobs) is showing south, west and elevation movement in meters. The time (iday) is day from Jan 1, 2015.

In this homework we are trying to determine tidal effects on the ice shelve. Note than the tides near the Ross shelf has a maximum displacement of 0.5m and observed standard deviation is ~10m.

This is a poor quality GPS.

1. Show that the state equation for the ice sheet is as below where *z can be neglected; r*, and *v* are displacement and the speed of the ice sheet; v_z can be neglected and v_a are vertical depth and radial acceleration error terms. Δt is the time between measurements.

$$\mathbf{s}_k = \mathbf{F}^{\mathbf{s}}_{k-1}\mathbf{s}_{k-1} + \mathbf{B}^{\mathbf{s}}_{k-1}\mathbf{v}^{\mathbf{s}}{}_{k-1}$$

$$\begin{bmatrix} z_s \\ r_s \\ v_s \end{bmatrix}_k = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & \Delta t \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} z_s \\ r_s \\ v_s \end{bmatrix}_{k-1} + \begin{bmatrix} 1 & 0 \\ 0 & \frac{\Delta t^2}{2} \\ 0 & \Delta t \end{bmatrix} \begin{bmatrix} \mathrm{v}_{z_s} \\ \mathrm{v}_{a_s} \end{bmatrix}_{k-1}$$

Implement this filter, for hint, see slides.

2 find the spectrum. Using any method, but we are only interested in the physical spectrum. Some suggestions:

%METHOD ONE

```
y=ycorr.';  % ycorr has the linear trend removed
fr=0:0.05:12;
Nsize=length(fr);
A=exp(1i*2*pi*iday*fr);
spec=A\y; %simplest estimate
```

%METHOD TWO, here the "20" is a Lagrange multiplier

```
cvx_begin quiet
    variable m_cvx(Nsize) complex;
    minimize 20*norm(m_cvx,1)+norm((A*m_cvx-y),1);
cvx_end
```