

### 8.3. Chirp changes in the frequencies of the multi sinusoidal disturbances

The chirp change in the frequencies of the disturbances can be generated with the Simulink block “**test\_chirp**” given in the file **test\_chirp.zip**. One can specify 1, 2, or 3 sinusoids, their frequencies and magnitude values, the time of application, the duration of the chirp, the initial and final values of the frequencies of the disturbances.

The initial values of the frequencies are specified in the vector **Fbeg**, the final value of the frequencies are specified in the vector **Ffin**.

The loop is closed before **T0**.

**T=0** no disturbance, closing of the loop

**T=T0**: The disturbances corresponding to **Fbeg** will be applied

**T=T1**: The chirp starts i.e. the values of the frequencies will vary linearly toward the values defined by **Ffin**

**T=T1+Tb**: The chirp stops at **T1+Tb** and the sinusoidal disturbances defined by **Ffin** are applied

**T=T1+Tb+T2** A new chirp starts. The frequencies of the disturbances will vary linearly towards the values defined by **Fbeg**

**T=T1+Tb+T2+Tb**: The chirp stop and the frequencies defined by **Fbeg** are applied

**T=T1+Tb+T2+Tb+T2** End of the experiment

The values of **T0**, **T1** and **T2** are the same for the three levels and are equal to:

**T0 = 5sec, T1=10sec, T2=5sec.**

**Tb** is the chirp duration, and it is used to define de chirp speed.

$$Tb = \frac{Ffin - Fbeg}{desired\_speed}$$

#### **Protocol to be used:**

For each test, the variation speed between two situations is maintained constant.

Disturbance amplitude is **0.1V** for each sinusoid.

#### **Single sinusoidal disturbance (level 1):**

*Variation rate (speed) = 10 Hz/sec*

The test to be done with the corresponding **Fbeg**, **Ffin** and **Tb** is described below:

**Fbeg = 50Hz, Ffin = 95Hz.**

$$Tb = \frac{Ffin - Fbeg}{desired\_speed} = \frac{95 - 50}{10} = 4.5 \text{ sec}$$

#### **Two sinusoidal disturbances (level 2):**

*Variation rate (speed) = 5 Hz/sec*

The test to be done with the corresponding **Fbeg**, **Ffin** and **Tb** is described below:

**Fbeg = [50-70]Hz, Ffin = [75-95]Hz.**

$$T_b = \frac{F_{fin} - F_{beg}}{\text{desired\_speed}} = \frac{[75 - 95] - [50 - 70]}{5} = 4 \text{ sec}$$

**Three sinusoidal disturbances (level 3):**

*Variation rate (speed) = 3 Hz/sec*

The test to be done with the corresponding **Fbeg**, **Ffin** and **Tb** is described below:

$F_{beg} = [50-65-80]\text{Hz}$ ,  $F_{fin} = [65-85-95]\text{Hz}$ .

$$T_b = \frac{F_{fin} - F_{beg}}{\text{desired\_speed}} = \frac{[65 - 85 - 95] - [50 - 65 - 80]}{3} = 5 \text{ sec}$$

If the block “test\_chirp” is used independently one has to specify the sampling frequency (800Hz).

As indicated in the chapter “evaluation of the adaptive controller” it is expected that the time sequence will remain the same for all the situations but the values of the frequencies may be changed (in the final test, these values will be selected randomly).