

# Dinâmica das Estruturas

## Atividade Prática 02

Leandro dos Reis Lopes – 1º Ten QEM

# Objetivos

- Apresentar o modelo experimental de Shear Building;
- Apresentar os diferentes tipos e princípios físicos dos acelerômetros;
- Apresentar a base vibratória de 1GL;
- Proceder diferentes tipos de excitação dinâmica;
- Realizar a aquisição de sinais acelerométricos;
- Observar o fenômeno da ressonância no modelo de Shear Building;
- Processar os sinais no Matlab inferindo frequência natural.

# Motivação

globoplay Agora na TV Novelas Séries Filmes Infantil Explore



Fantástico >

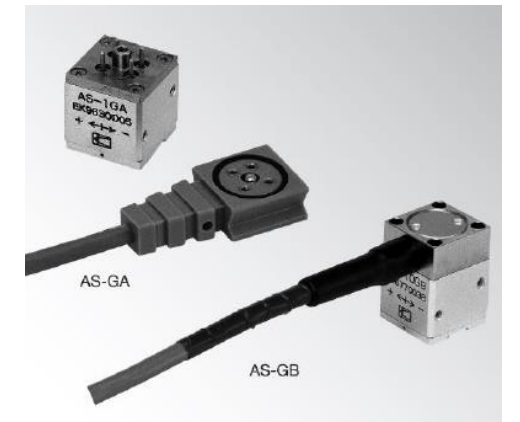
## Chuva e ventos fortes em Balneário Camboriú fazem prédio balançar

3 min Exibição em 4 fev 2018



# Acelerômetros – Tipos e Princípios Físicos

- Servo-acelerômetro
- Acelerômetro FBG (Fiber Bragg Grating)
- Acelerômetros Capacitivos
- Acelerômetros Piezoresistivos
- Acelerômetros Piezoelétricos
- Acelerômetros MEMs (Micro Eletromecânicos)

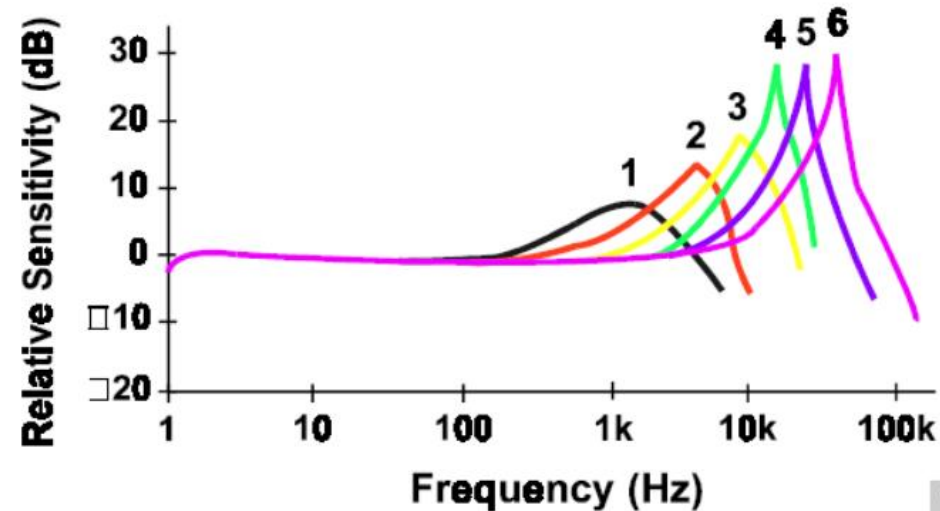
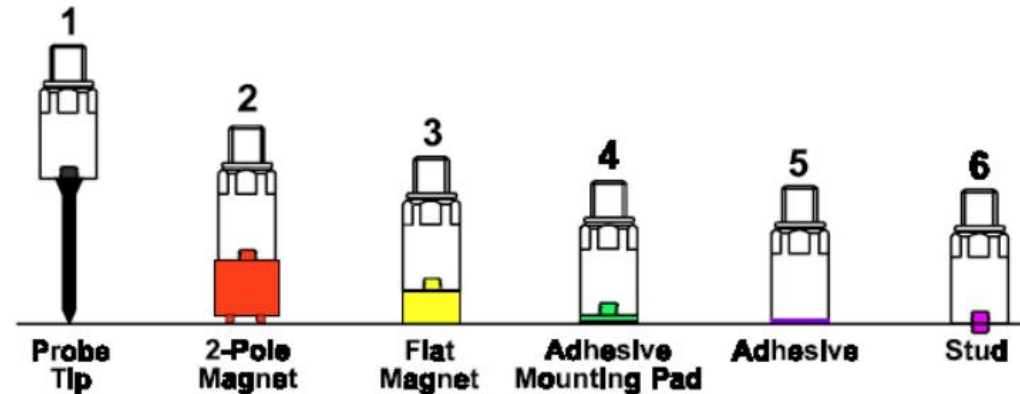


os7100 - Single Axis Accelerometer

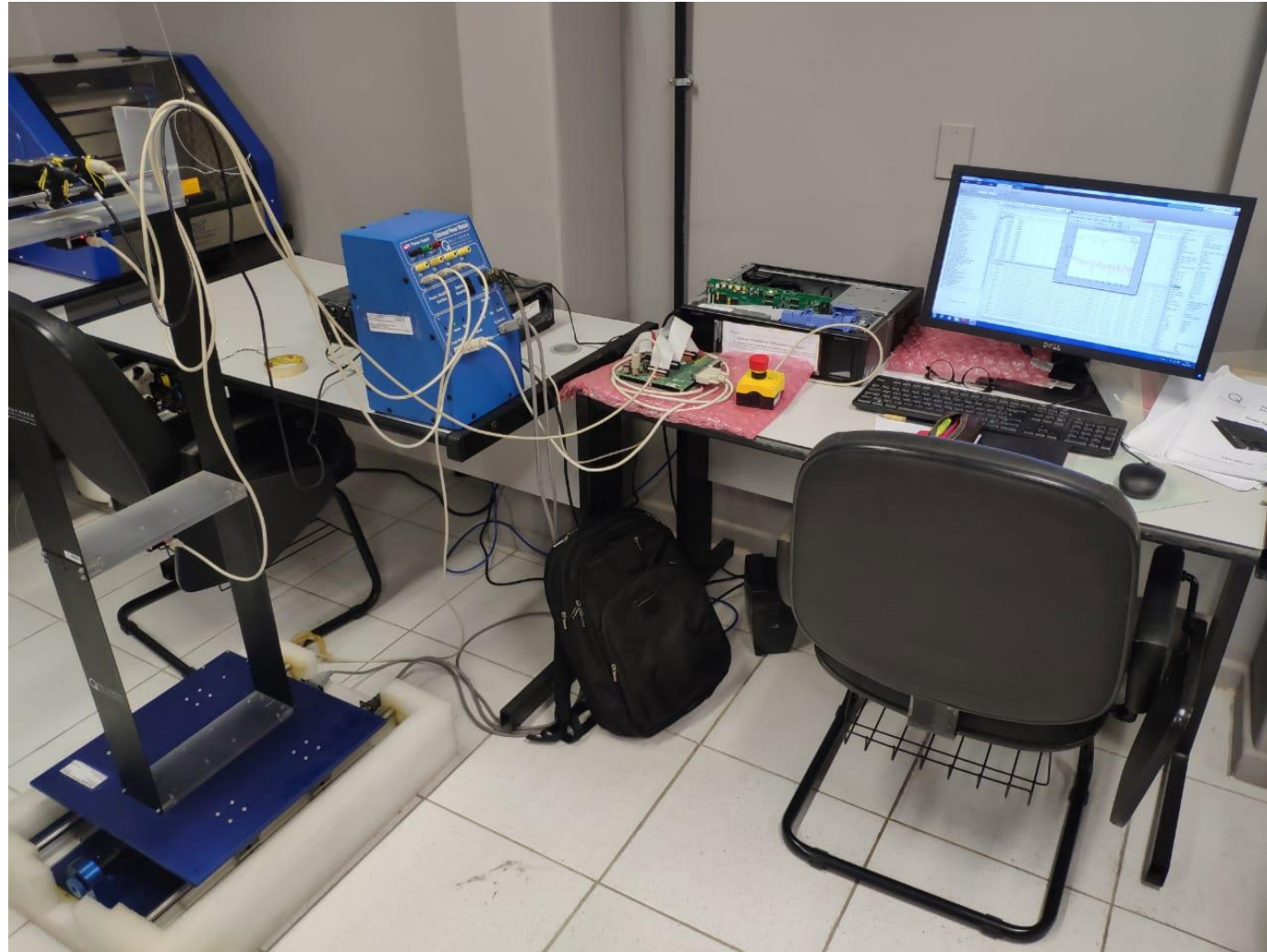


# Acelerômetros – Alguns cuidados importantes

- Eixos do acelerômetro alinhados aos eixos do sistema.
- Correta fixação dos acelerômetros no sistema.
- Locais de fixação dos acelerômetros.



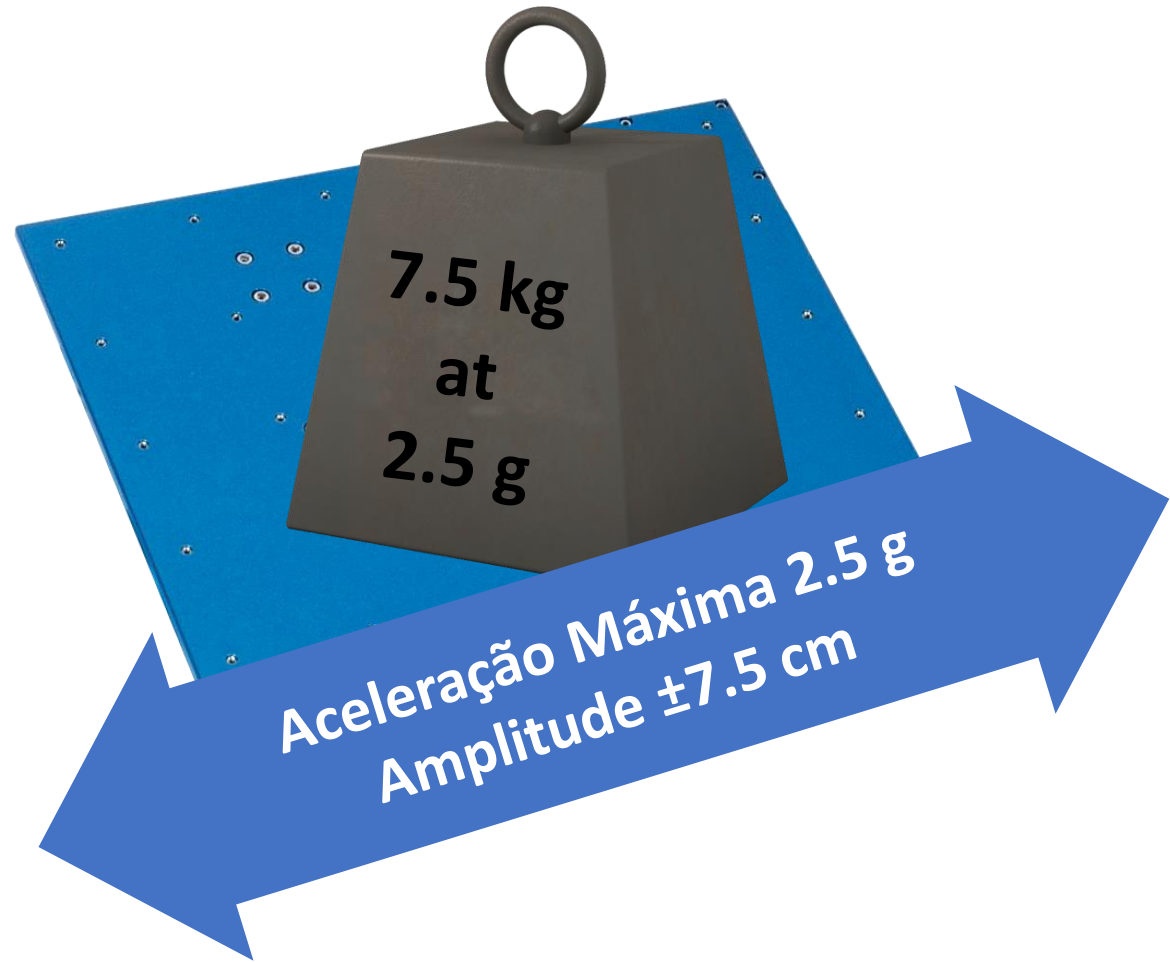
# Laboratório de Dinâmica



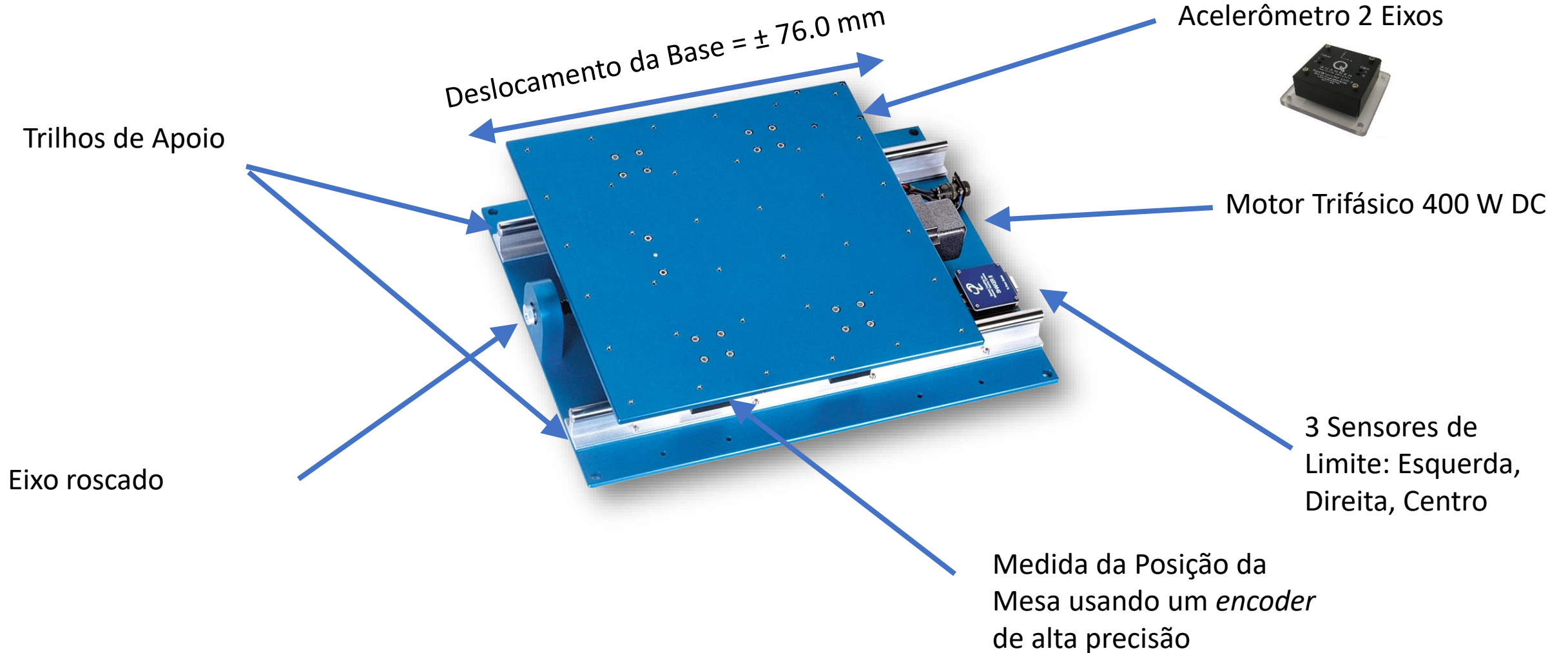


# Shake Table II

1. Máxima aceleração 2.5 g
2. Amplitude  $\pm 7.5$  cm
3. Peso máximo 7.5 kg at 2.5 g
4. Frequências até 10 Hz



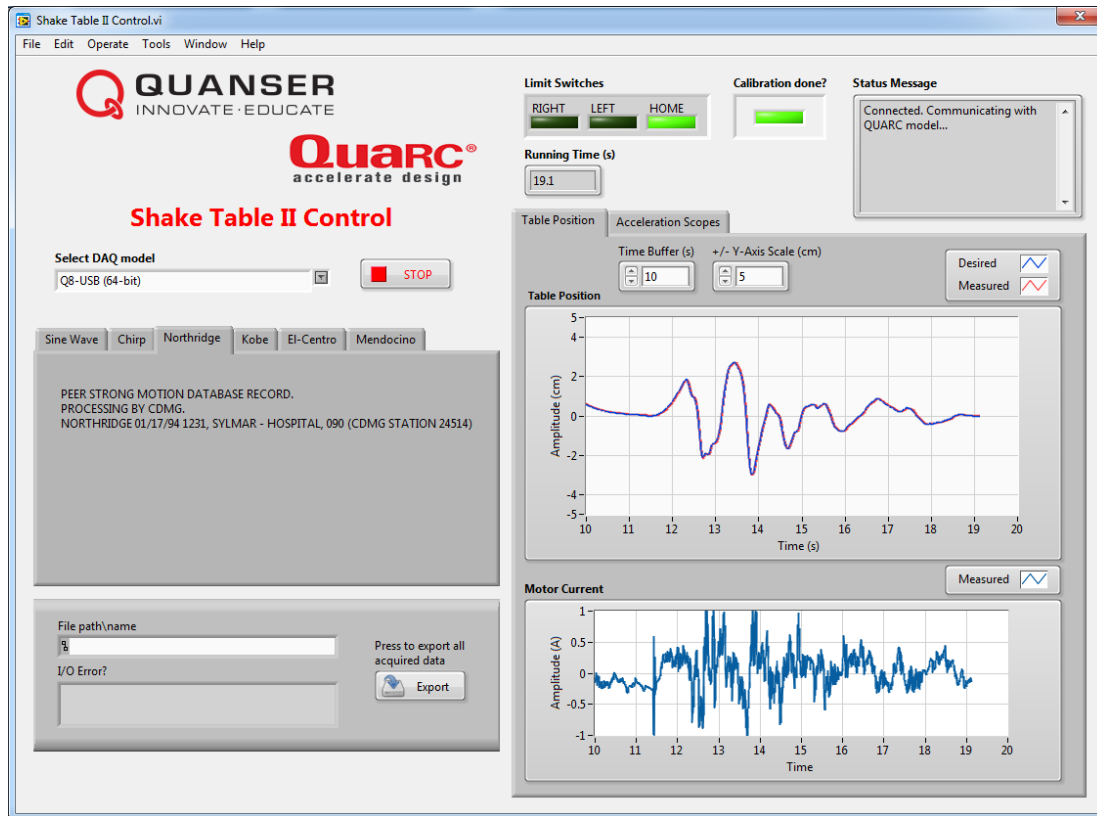
# Shake Table II



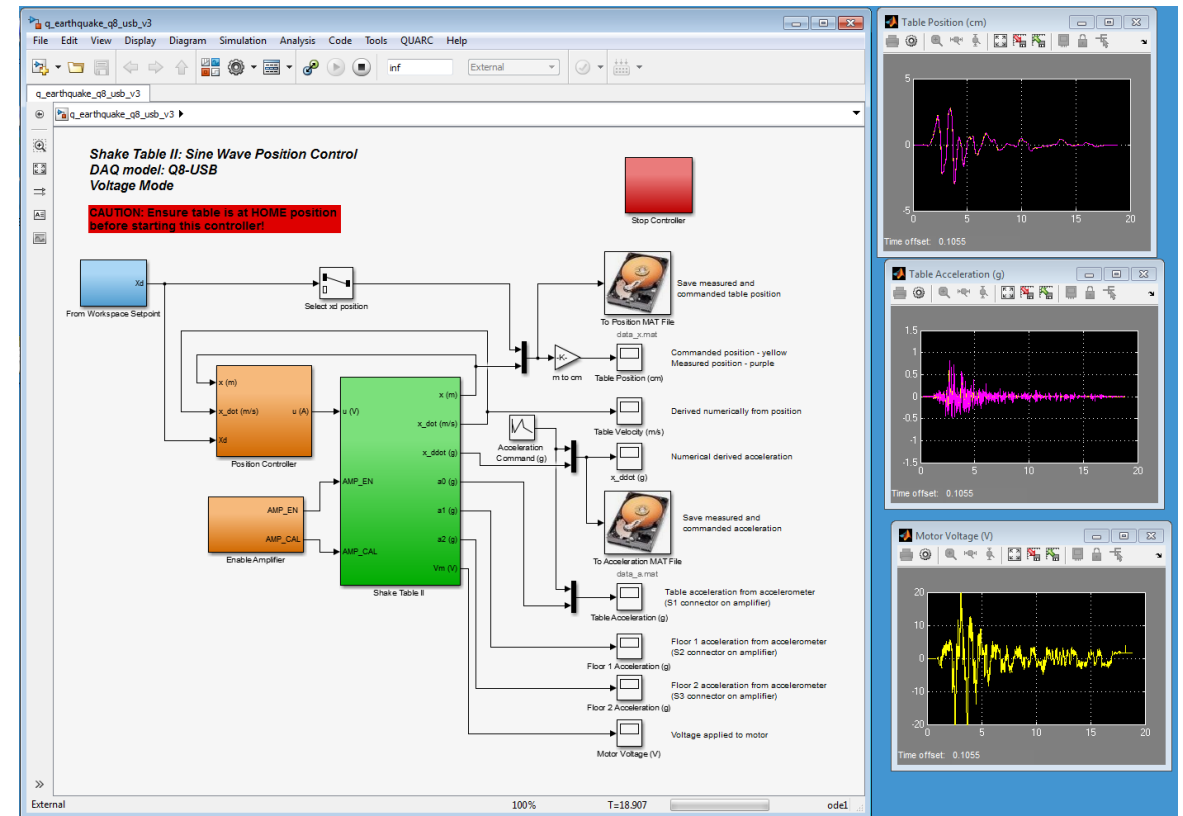


# Softwares para Controle e Aquisição de Dados

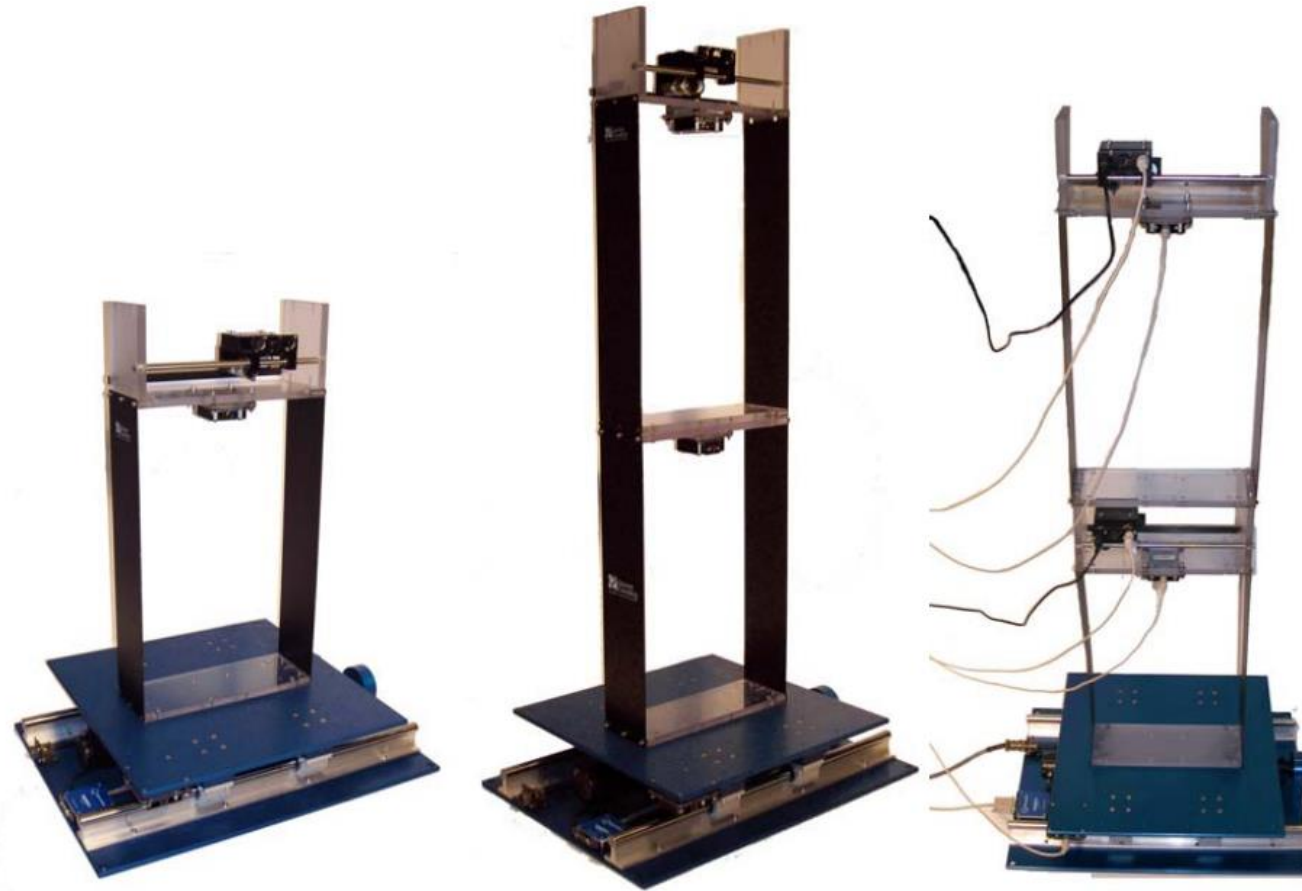
Software Próprio (LabView Runtime)



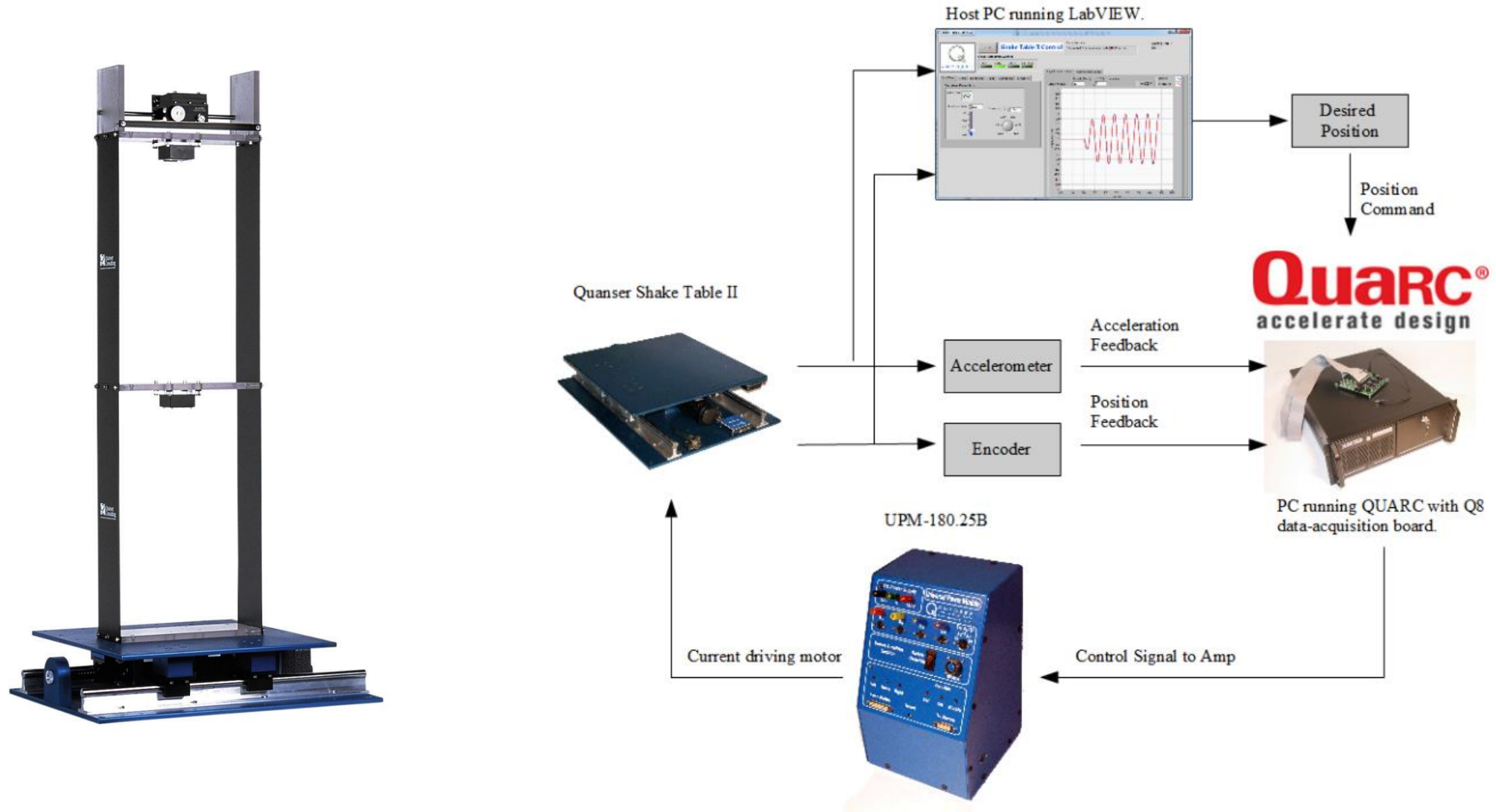
MatLab/Simulink



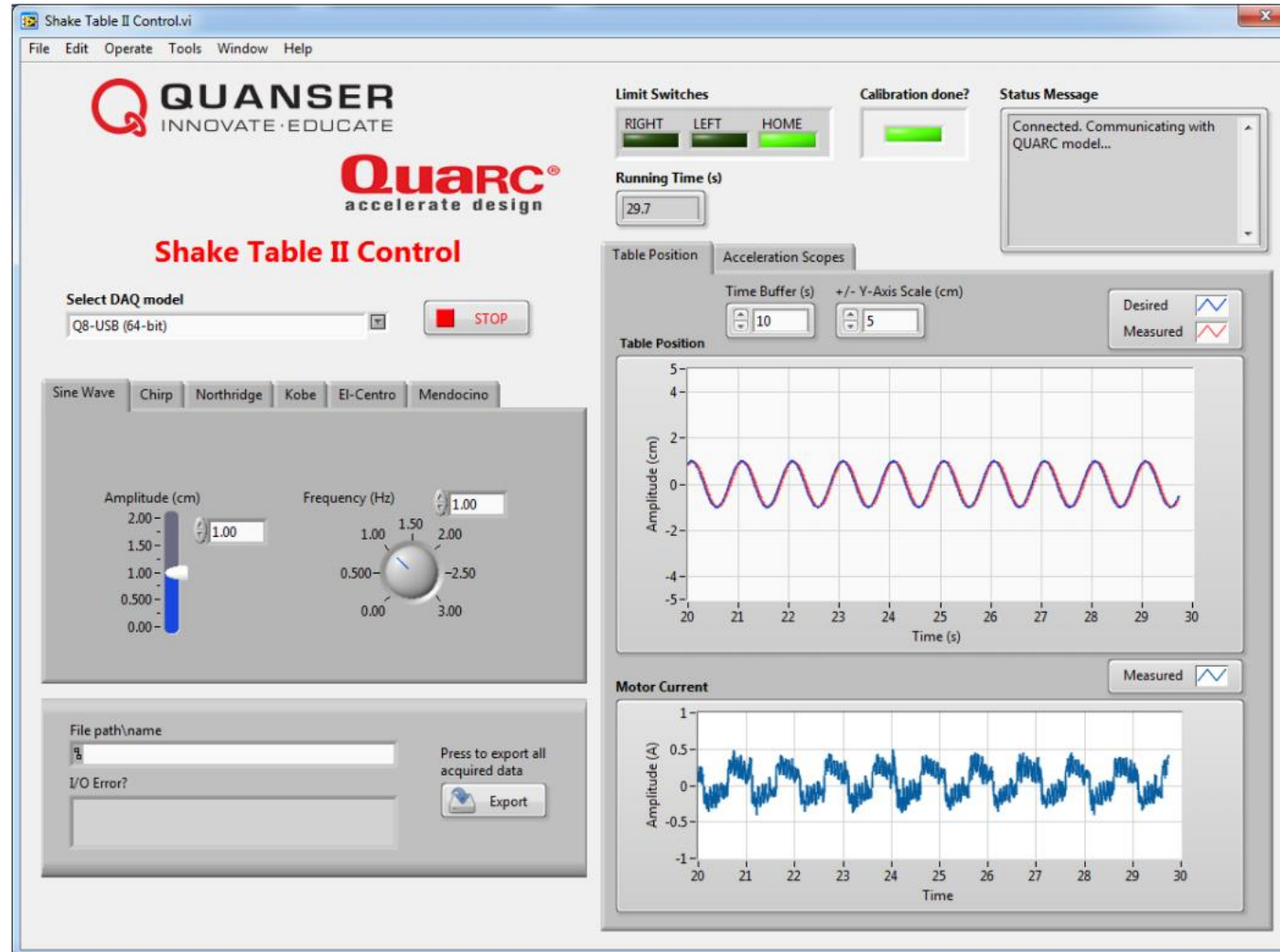
# Modelos de Shear Building



# Shake Table II - sistema



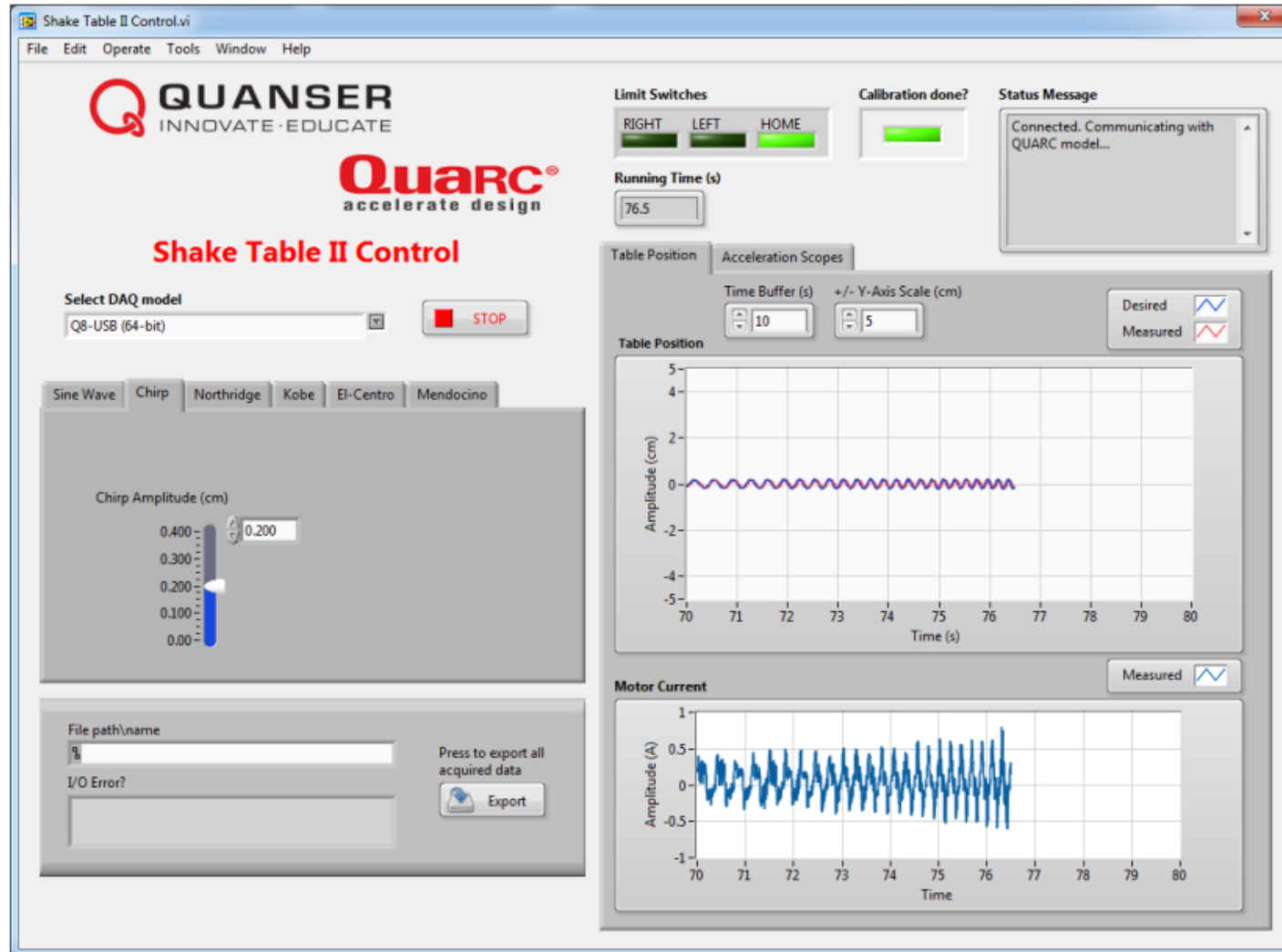
# Aquisição de Dados – Excitação Senoidal



# Aquisição de Dados – Excitação Senoidal

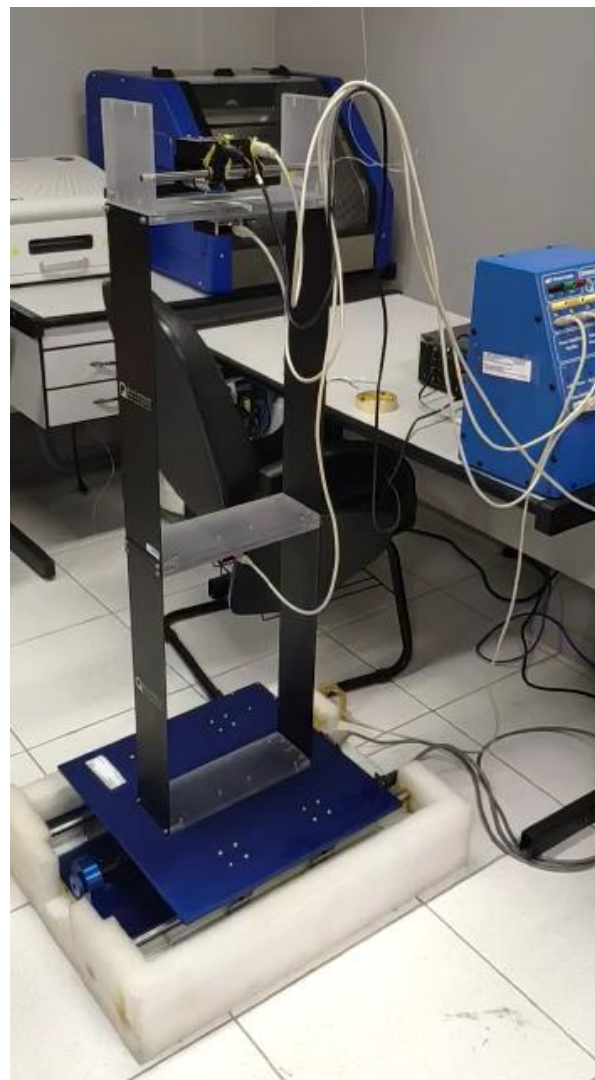


# Aquisição de Dados – Excitação Chirp

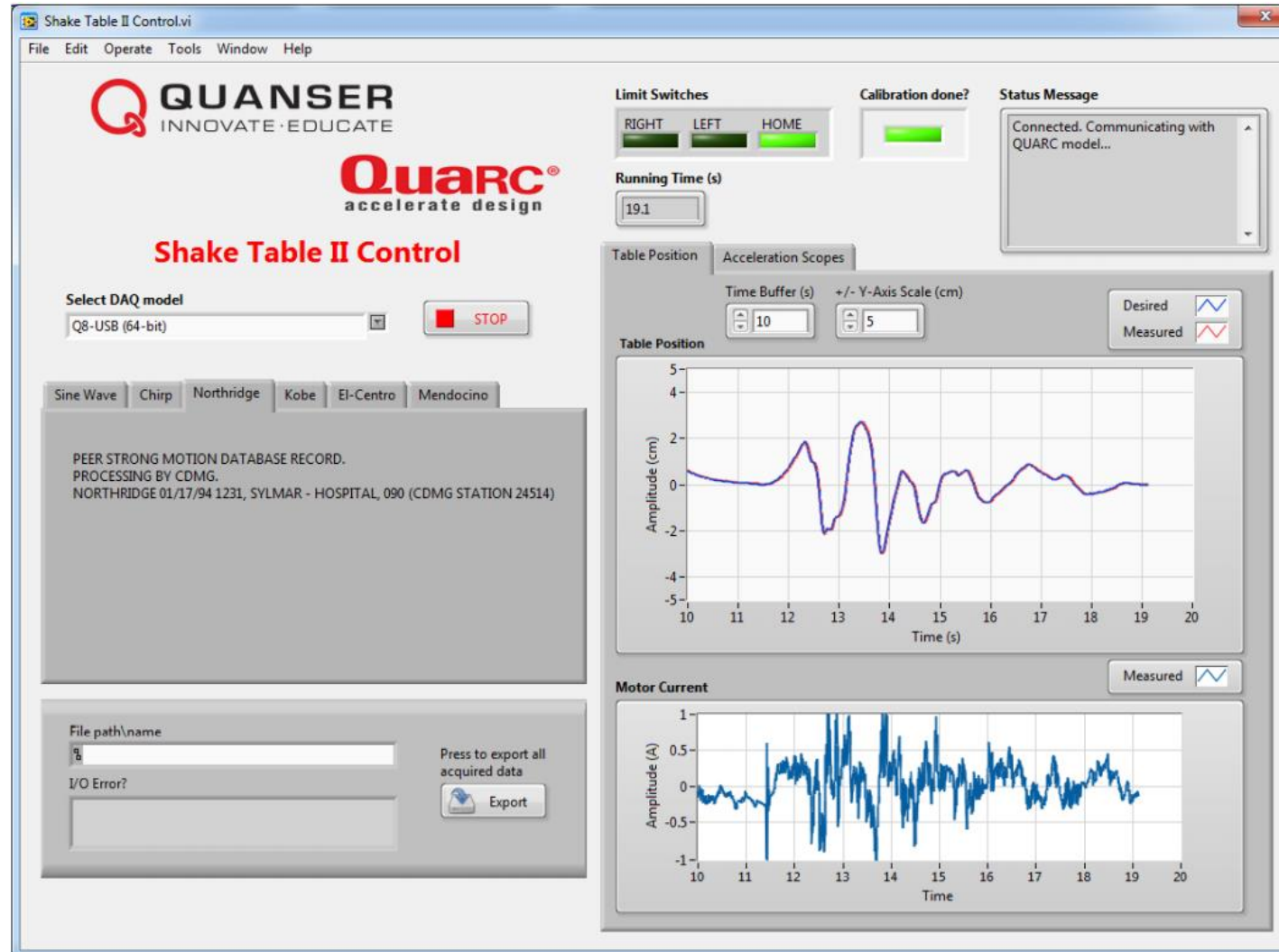




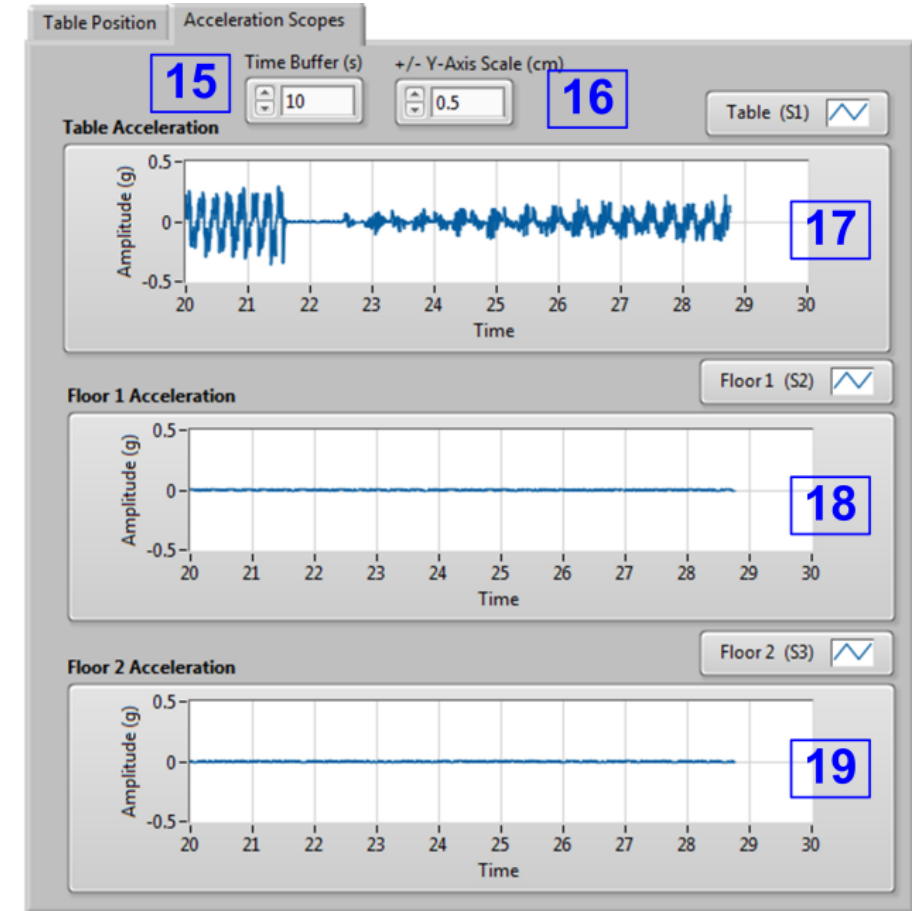
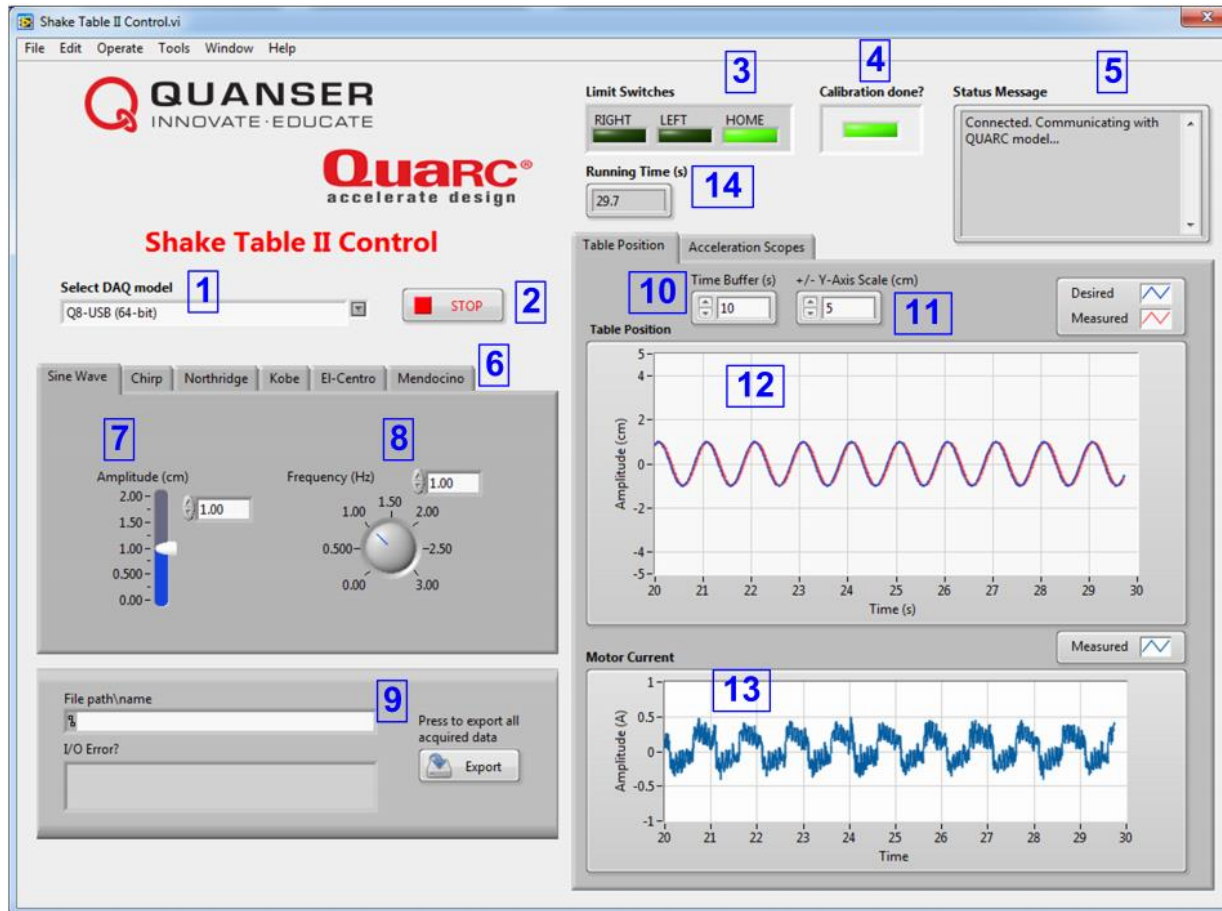
# Aquisição de Dados – Excitação Chirp



# Aquisição de Dados – Excitação Terremoto

































# Interface de Controle e Aquisição de Sinais



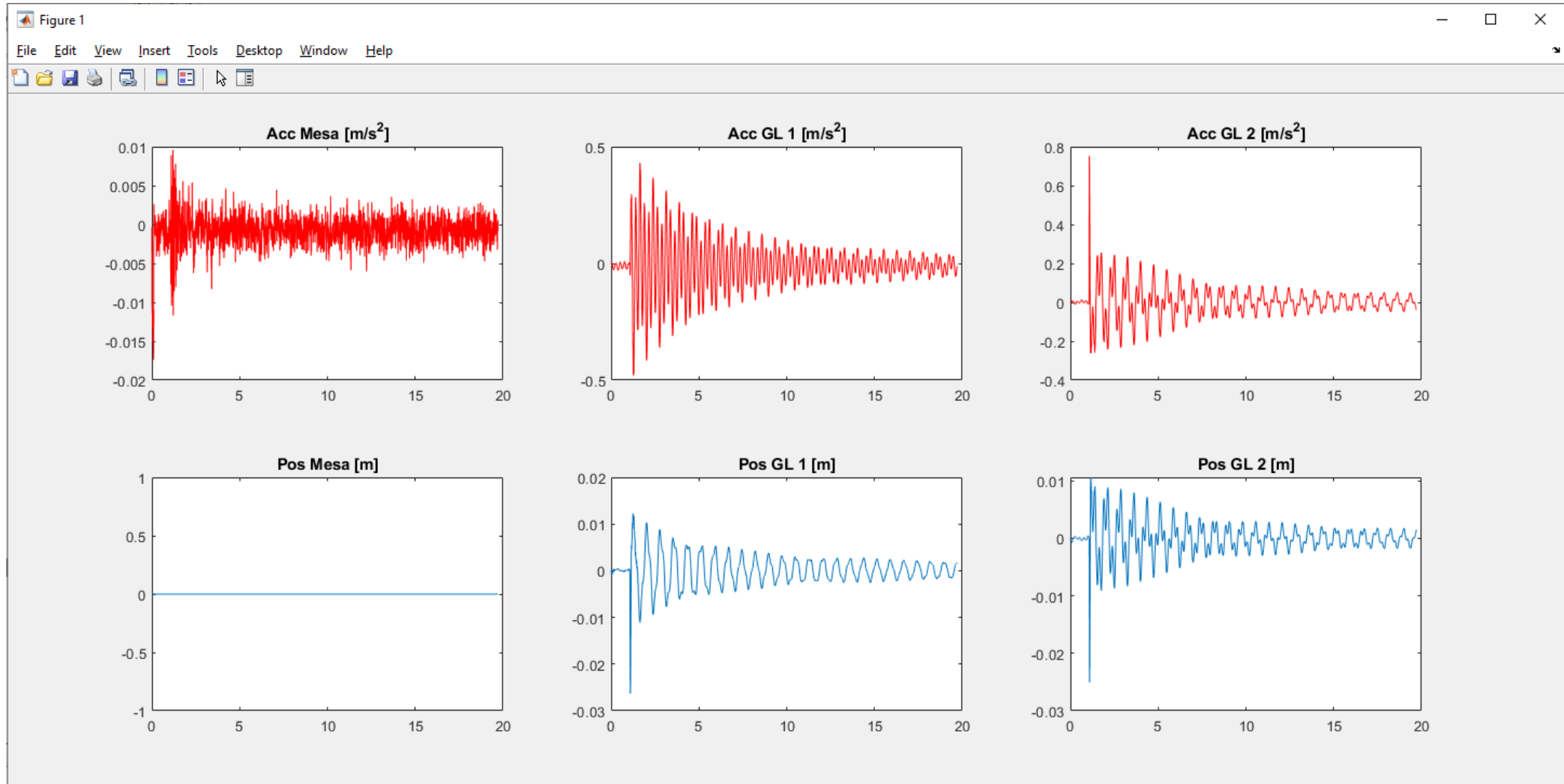
# Programa de Ensaaios

- Impacto
  - GL2
  - GL1
- Desloc. Inicial
  - Topo
- Frequência Constante (Seno)
  - Amplitudes:
    - 0.3, 0.4 e 0.5 (cm)
  - Frequências:
    - 0.5, 0.75, 1.00, 1.25, 1.50, 1.75 e 2.00 Hz
- Chirp
  - 0 a 10Hz em 20 segundos

# Dados dos Ensaios (arquivos .mat)

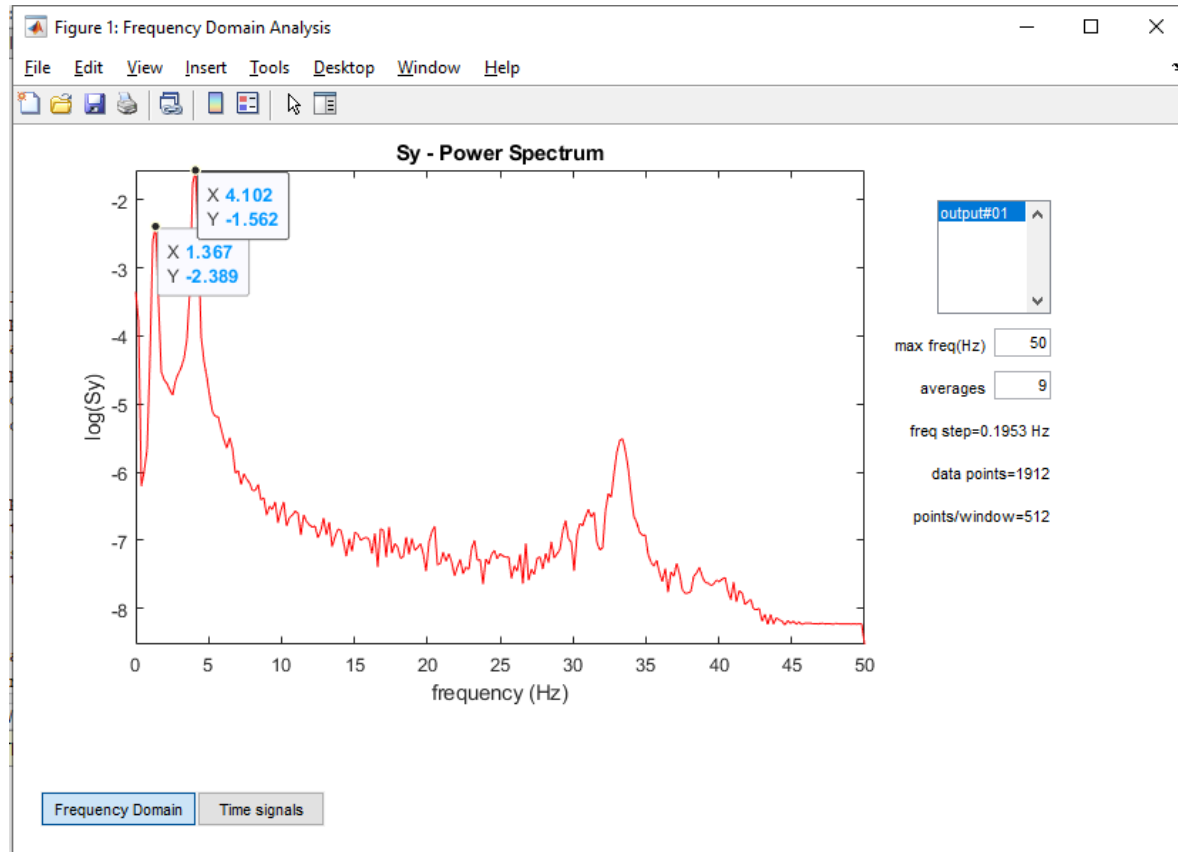
 Chirp1	✓	 Chirp2	✓	 DeslocamentoInicial	✓
 ImpactoMeio1	✓	 ImpactoMeio2	✓	 ImpactoTopo1	✓
 ImpactoTopo2	✓	 SineFreq050Amp030	✓	 SineFreq050Amp040	✓
 SineFreq050Amp050	✓	 SineFreq075Amp030	✓	 SineFreq075Amp040	✓
 SineFreq075Amp050	✓	 SineFreq100Amp030	✓	 SineFreq100Amp040	✓
 SineFreq100Amp050	✓	 SineFreq115Amp040	✓	 SineFreq125Amp030	✓
 SineFreq125Amp040	✓	 SineFreq125Amp050	✓	 SineFreq135Amp040	✓
 SineFreq150Amp030	✓	 SineFreq150Amp040	✓	 SineFreq150Amp050	✓
 SineFreq175Amp030	✓	 SineFreq175Amp040	✓	 SineFreq175Amp050	✓
 SineFreq200Amp030	✓	 SineFreq200Amp040	✓	 SineFreq200Amp050	✓

# Dados para Impacto (no Topo)

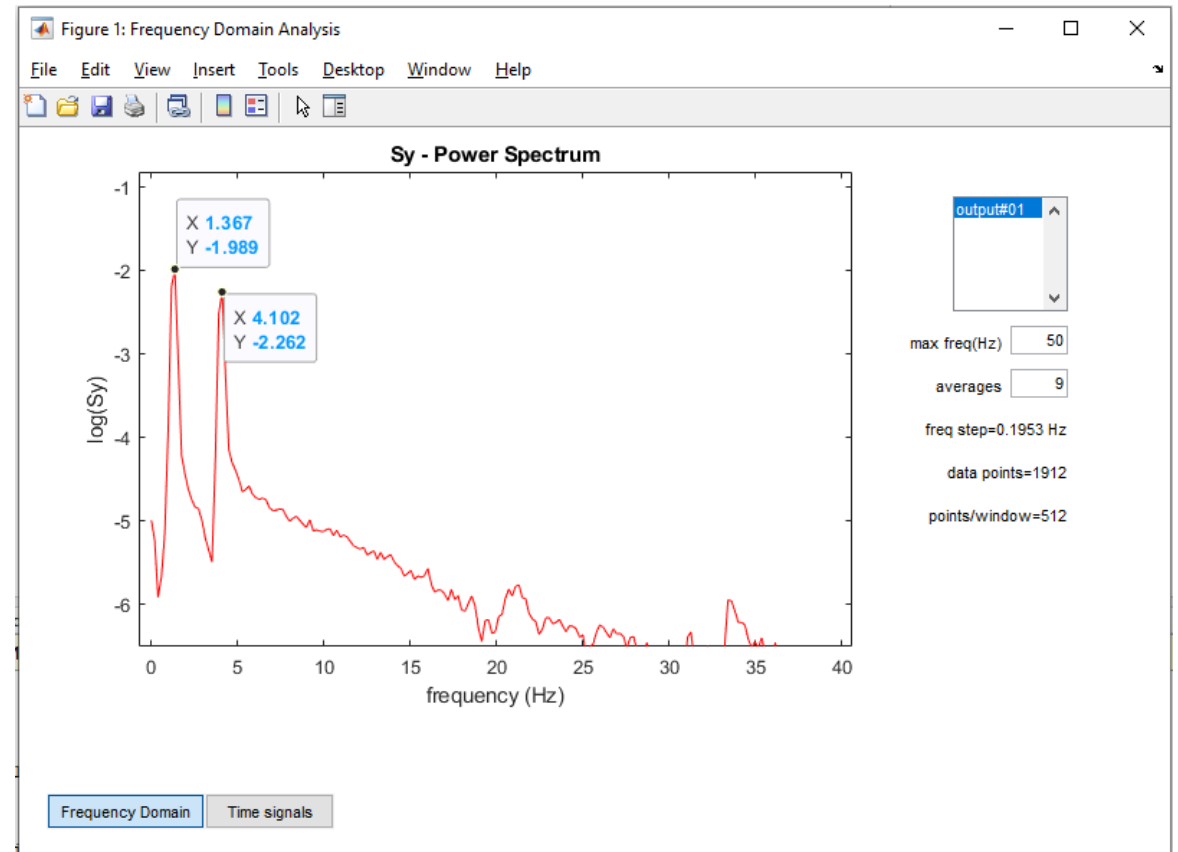




# Dados para Impacto (no Topo)

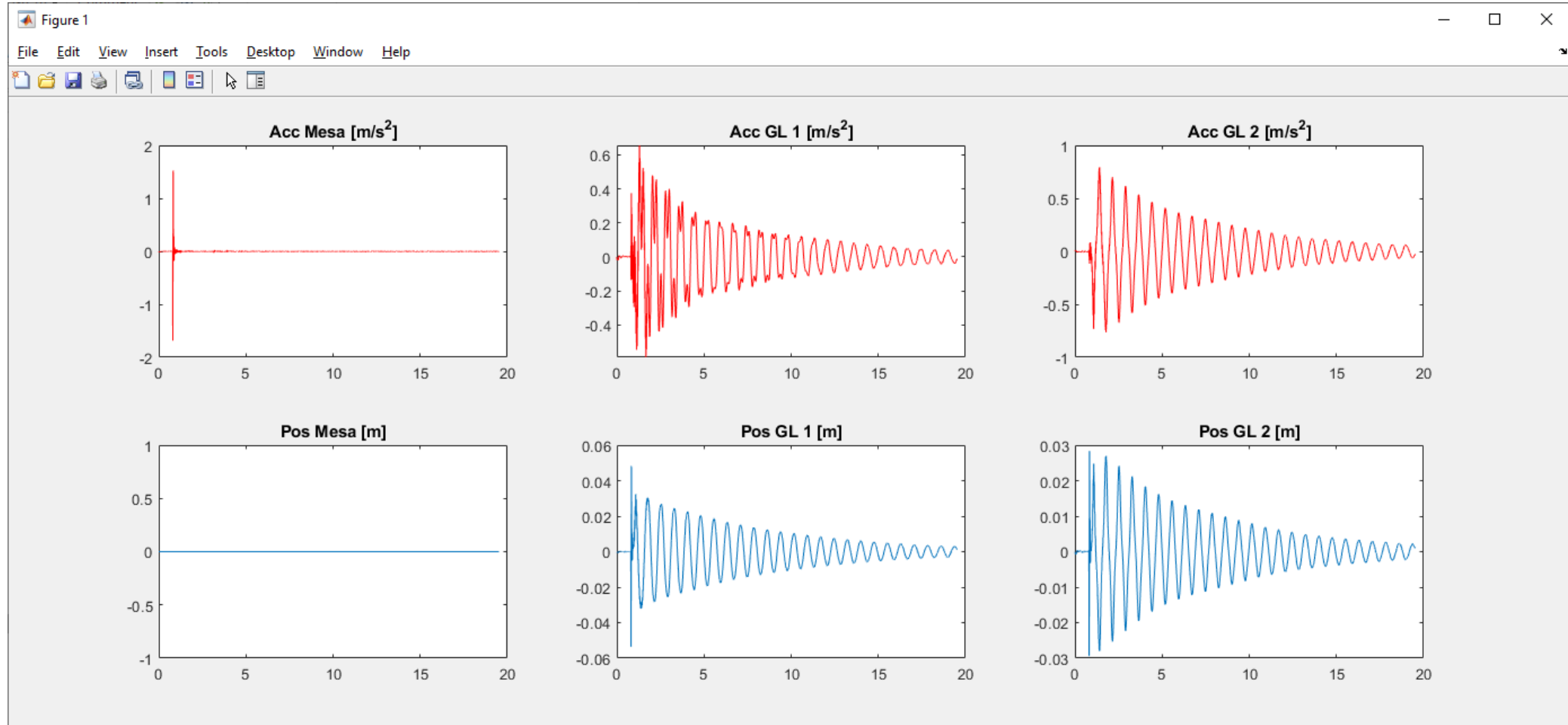


Acc no GL 1

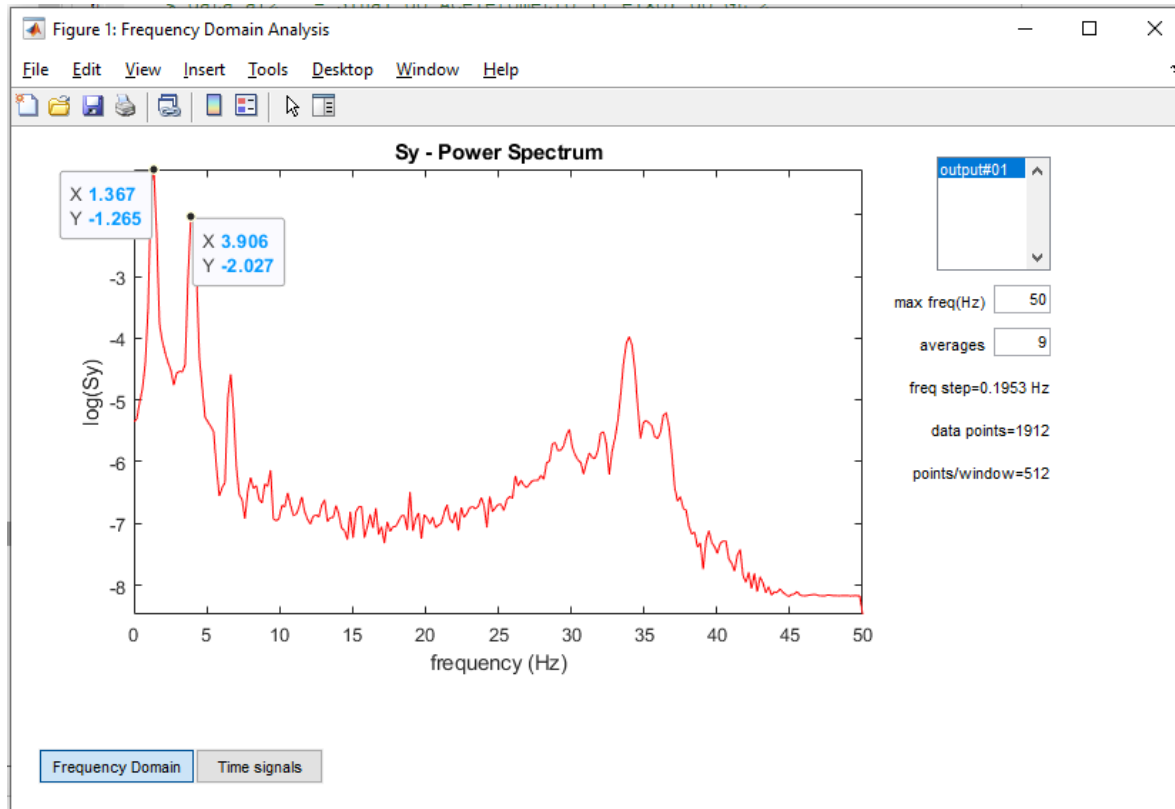


Acc no GL 2

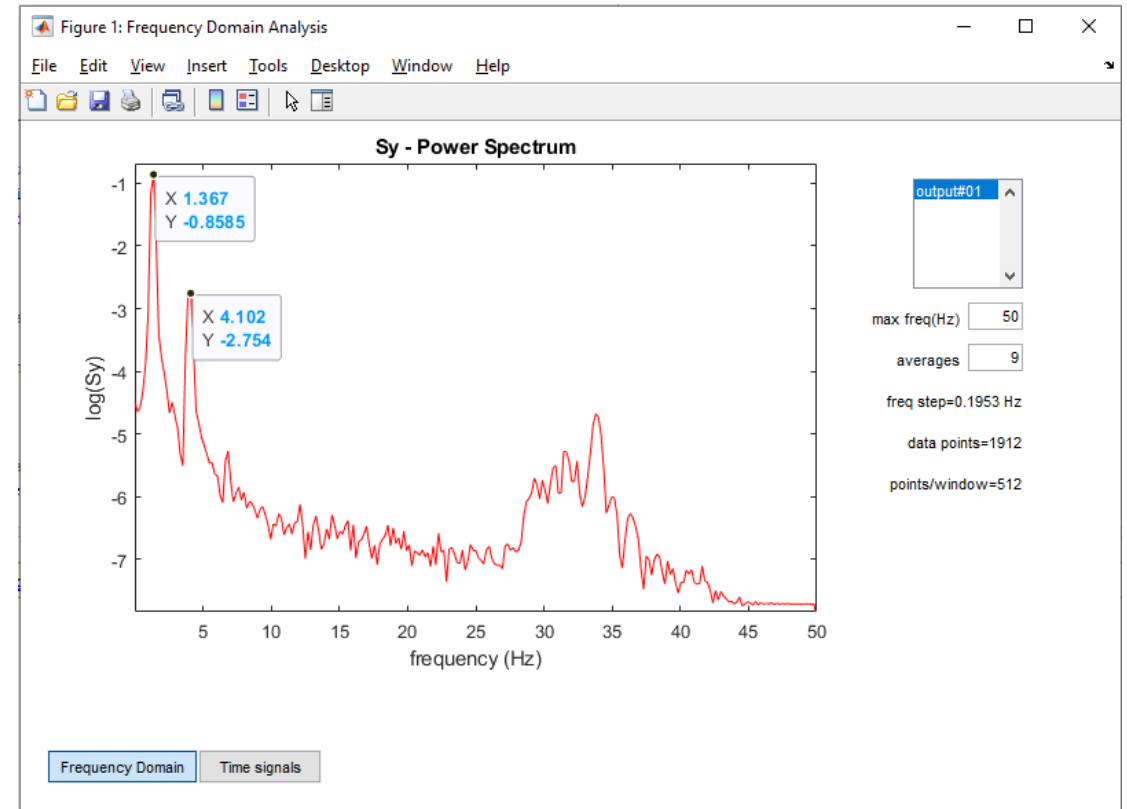
# Dados para Deslocamento Inicial



# Dados para Deslocamento Inicial

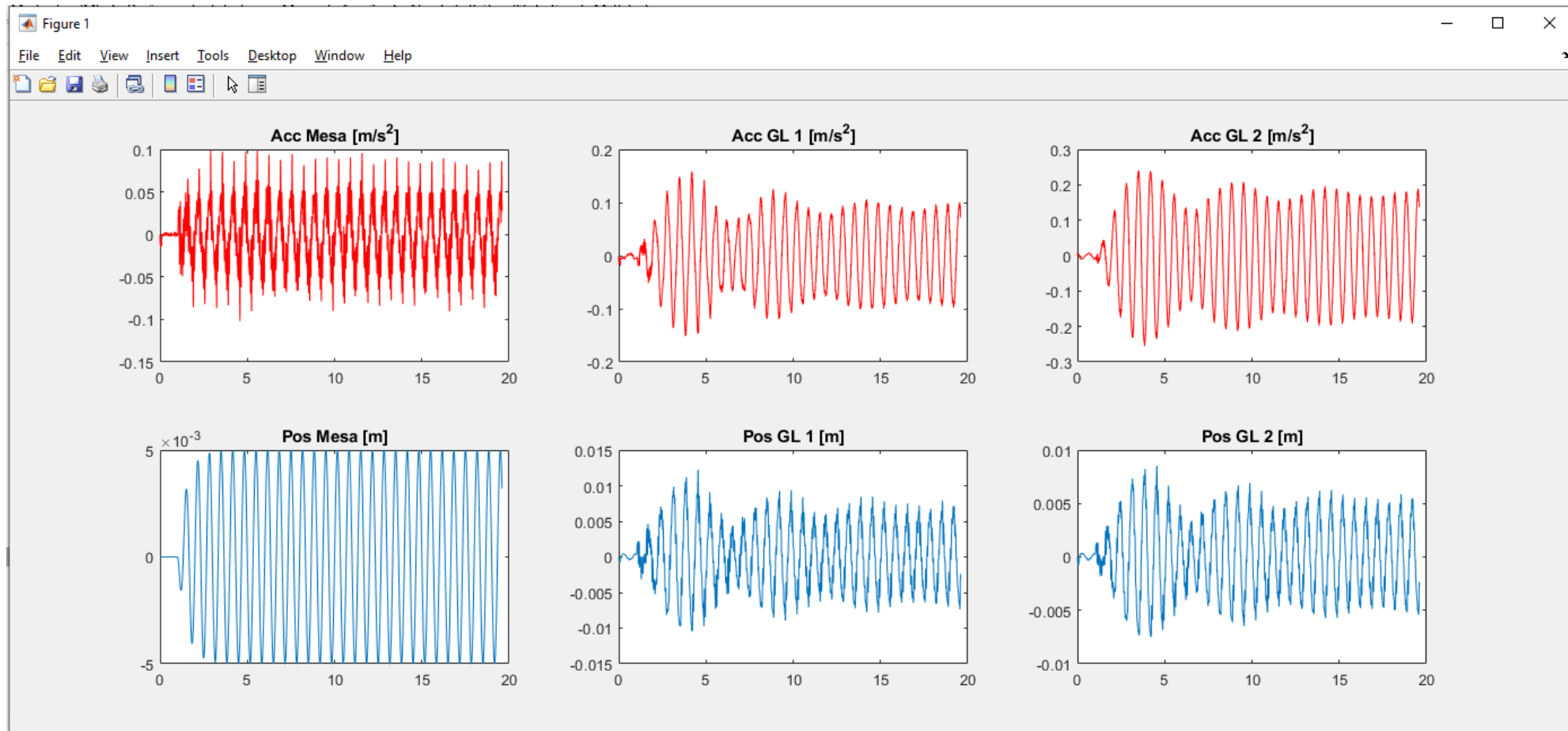


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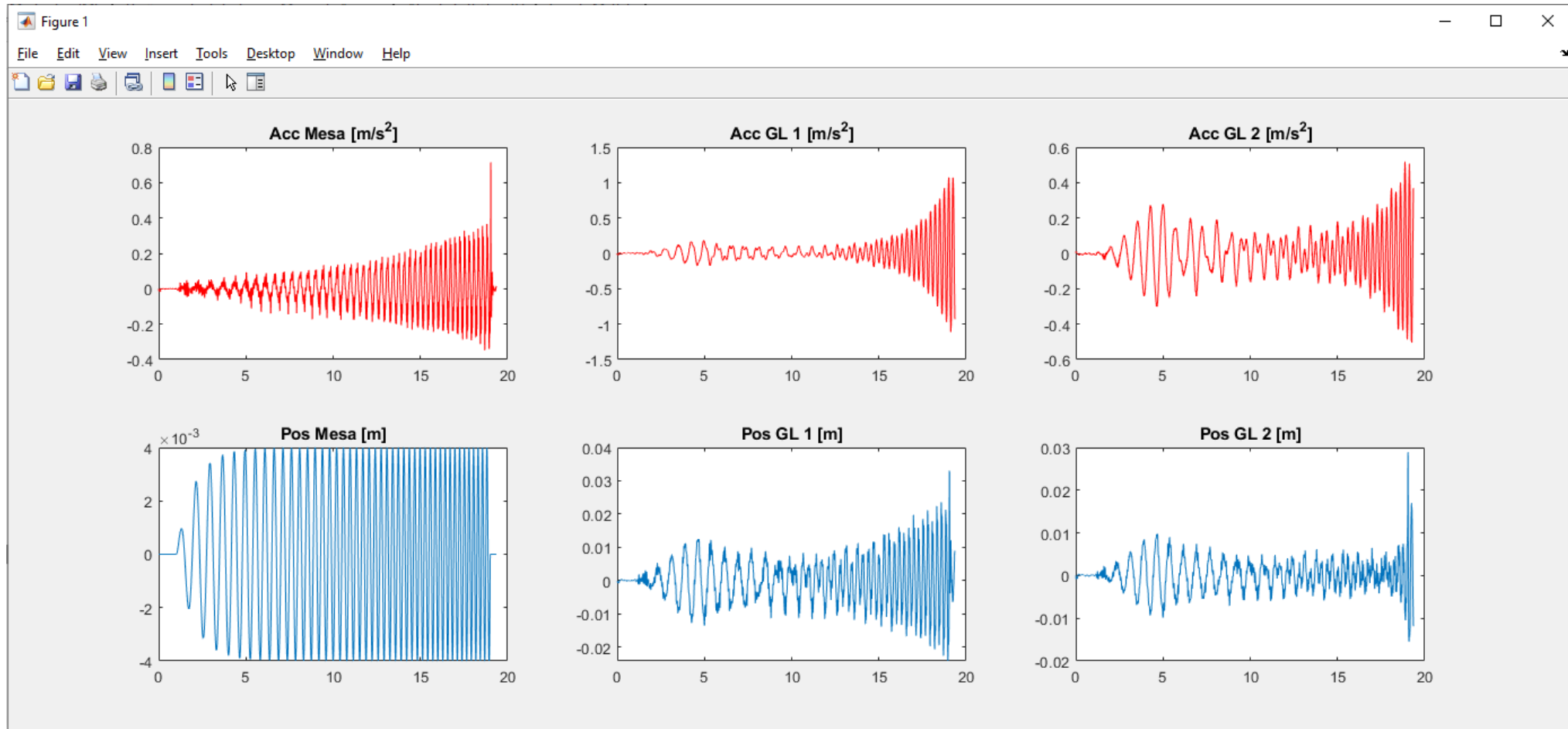


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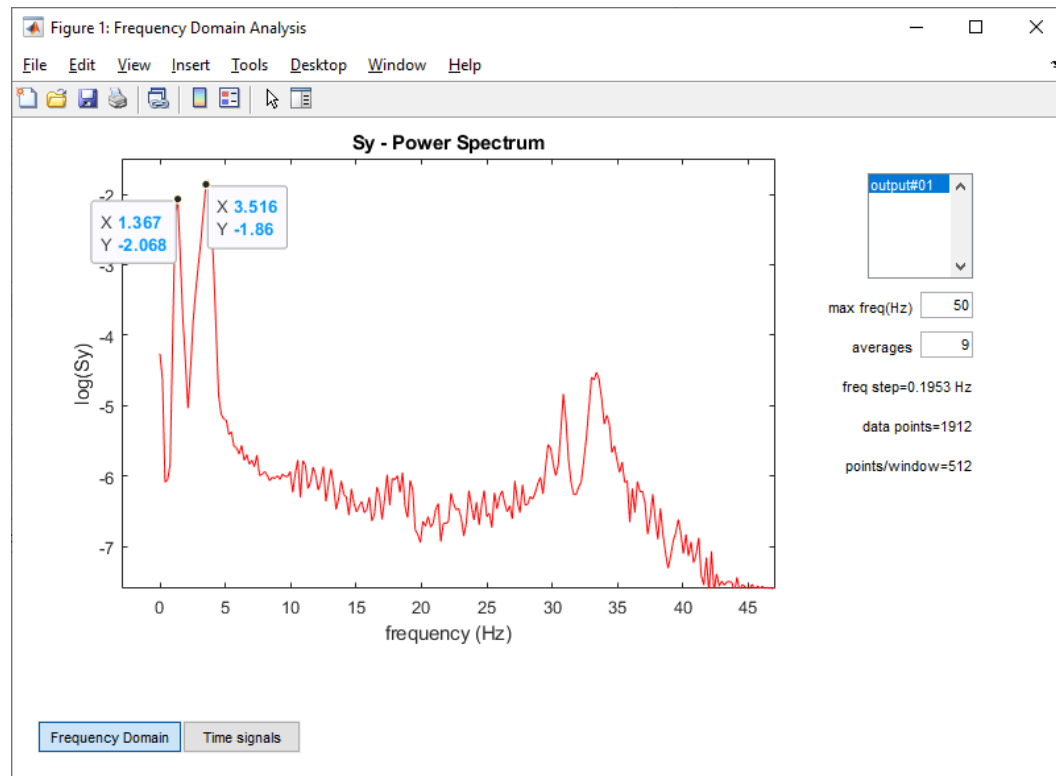
# Dados para Freq. Constante



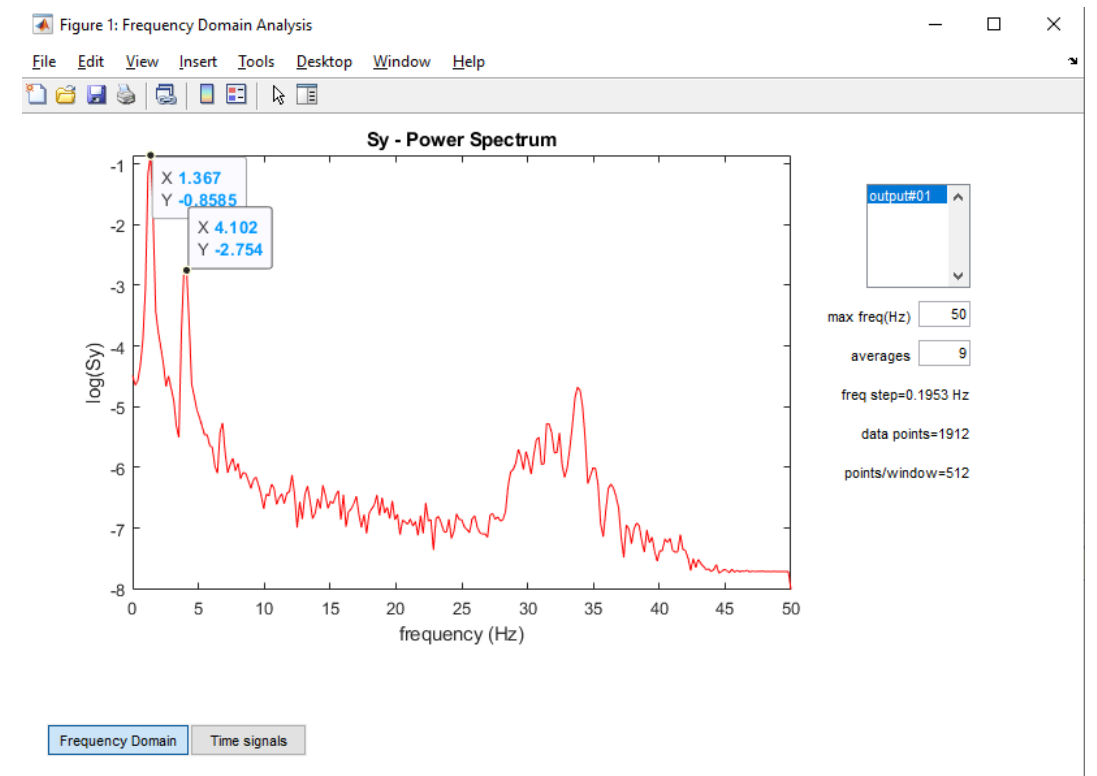
# Dados para Chirp



# Dados para Chirp



Acc no GL 1



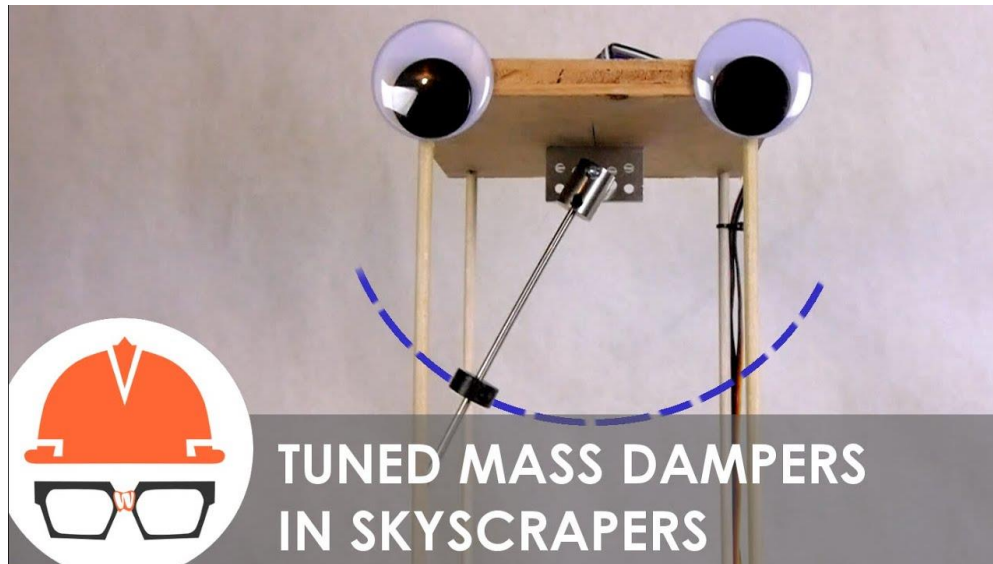
Acc no GL 2



# Como explorar esse equipamento?

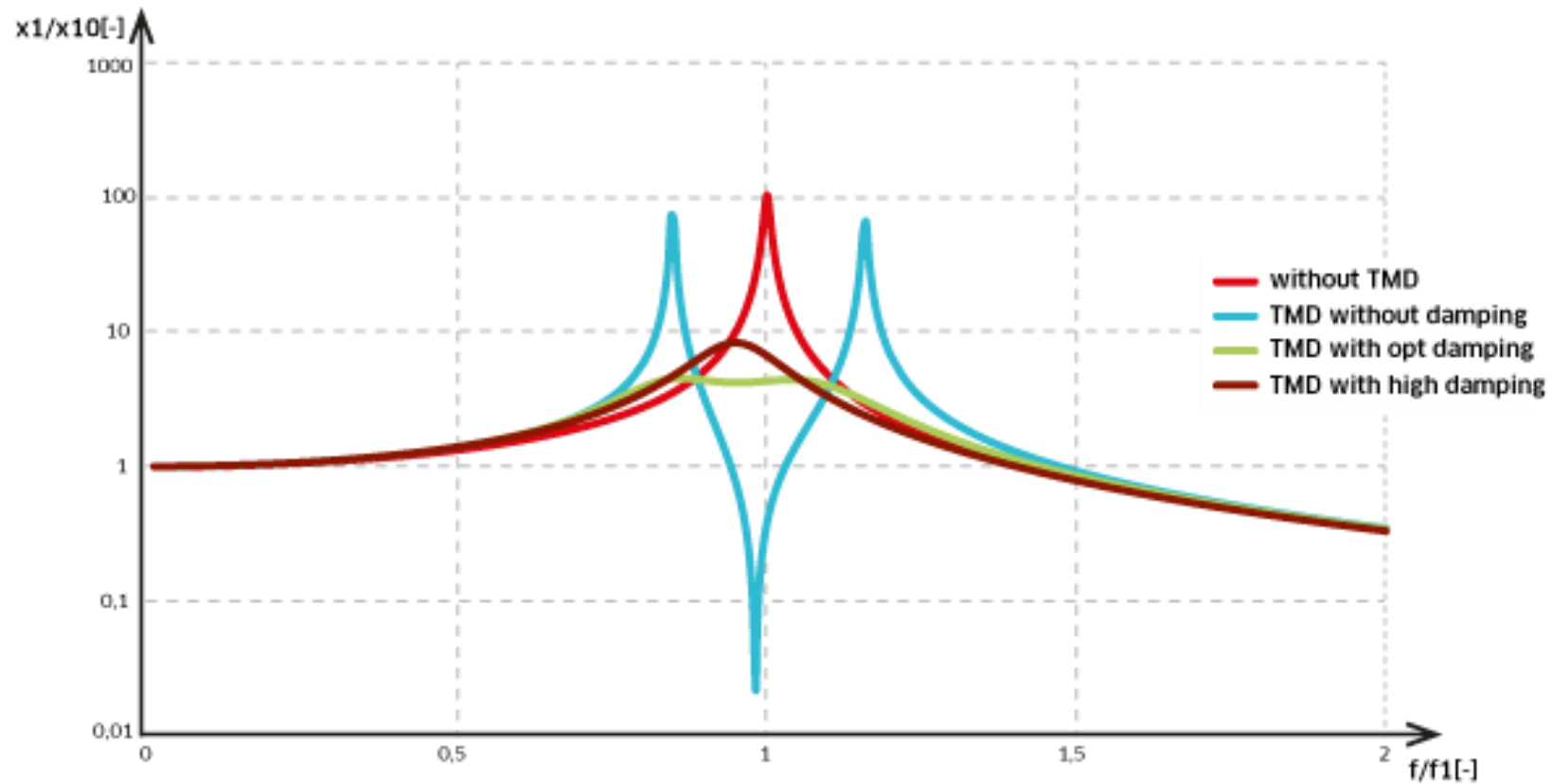
- Tuned Mass Damper

<https://www.youtube.com/watch?v=f1U4SAgy60c>



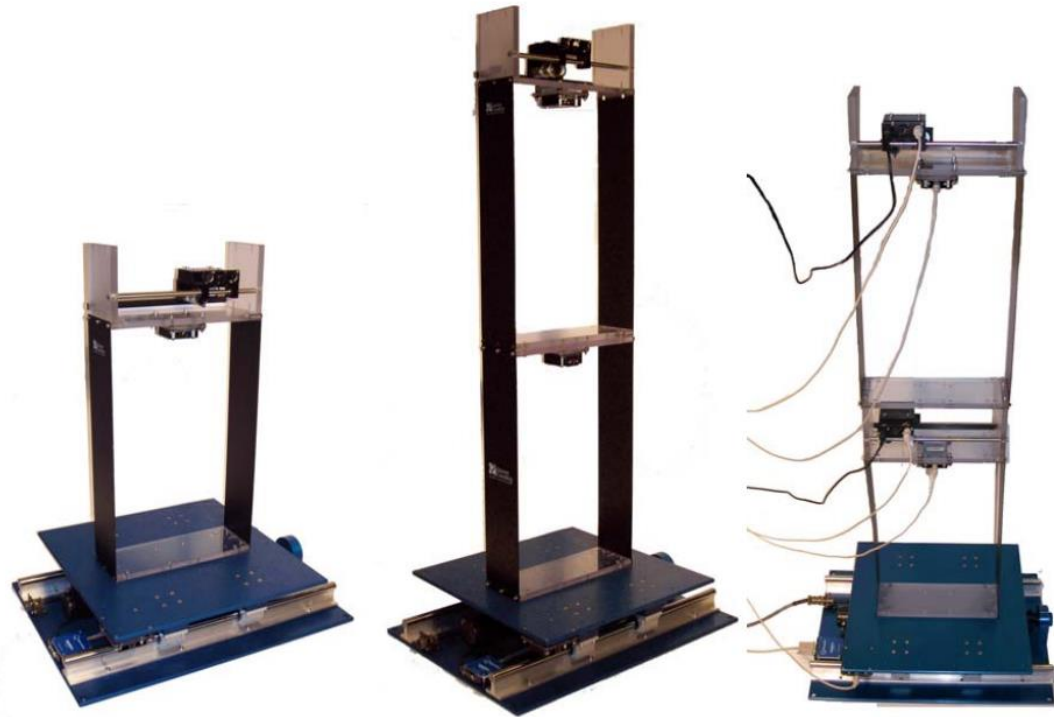
# Como explorar esse equipamento?

- Tuned Mass Damper



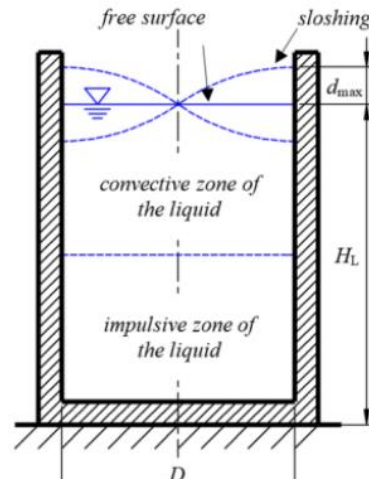
# Como explorar esse equipamento?

- Active Mass Damper

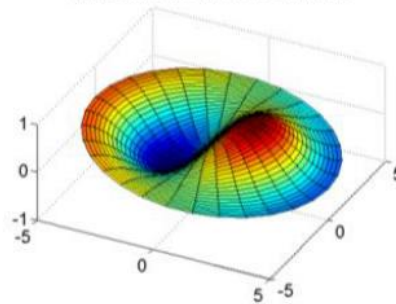


# Como explorar esse equipamento?

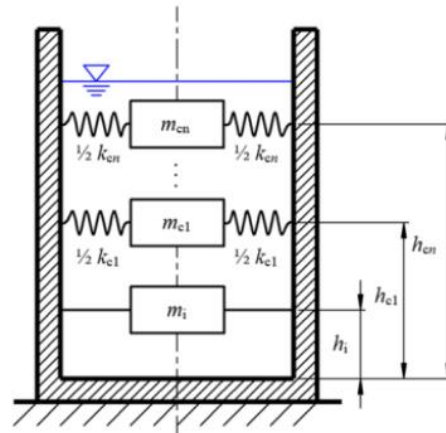
- Fenômeno de Sloshing - Tuned Liquid Damper



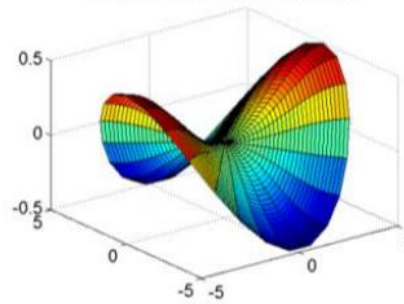
(1,2) convective mode of oscillation



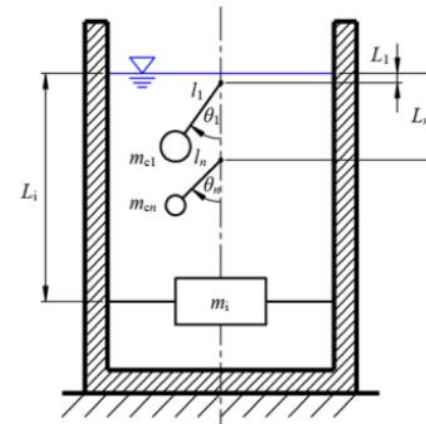
$$f_{c1,2} = 0.51 \text{ Hz}$$



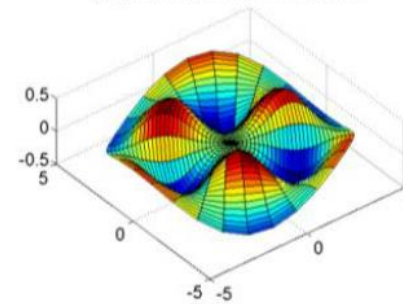
(2,1) convective mode of oscillation



$$f_{c2,1} = 0.39 \text{ Hz}$$



(3,2) convective mode of oscillation



$$f_{c3,2} = 0.63 \text{ Hz}$$

# Como explorar esse equipamento?

- Fenômeno de Sloshing - Tuned Liquid Damper
- Tuned Liquid Column Damper:  
<https://www.youtube.com/watch?v=JaldGw2lQ7g>
- Tuned Liquid Damper:

