Impulse function

$ORIGIN := 1$

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Physical parameters and natural frequency

$K := 150 \cdot 10^6 \cdot \frac{N}{m} = 8.565 \times 10^5 \cdot \frac{lbf}{in}$ stiffness and mass

$\zeta := 0.05$ damping ratio

$M := 300 \cdot kg = 661.387 \cdot lb$

$\omega_n := \left(\frac{K}{M}\right)^{.5} = 707.107\, s^{-1}$

$f_n := \frac{\omega_n}{2 \cdot \pi} = 112.54 \cdot Hz$ natural frequency and

natural period of motion $T_n := \frac{1}{f_n} = 8.886 \times 10^{-3}\, s$

$C := \zeta \cdot 2 \cdot (K \cdot M)^{.5} = 121.131 \cdot lbf \cdot \frac{s}{in}$ Damping coefficient

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$T := \frac{1}{1000} \cdot s$ duration of impulse (nominal) & amplitude

$F_I := 1000 \cdot N$

$Impulse := 2 \cdot \frac{T}{\pi} \cdot F_I = 0.637 \cdot N \cdot s$ area of F vs t curve

Sampling rate = MIN = 2 x max frequency

Sampling rate $\Delta rate := 10000 \cdot \frac{1}{s}$ **samples/s**

Number of samples $N_P := 2^{10} = 1.024 \times 10^3$

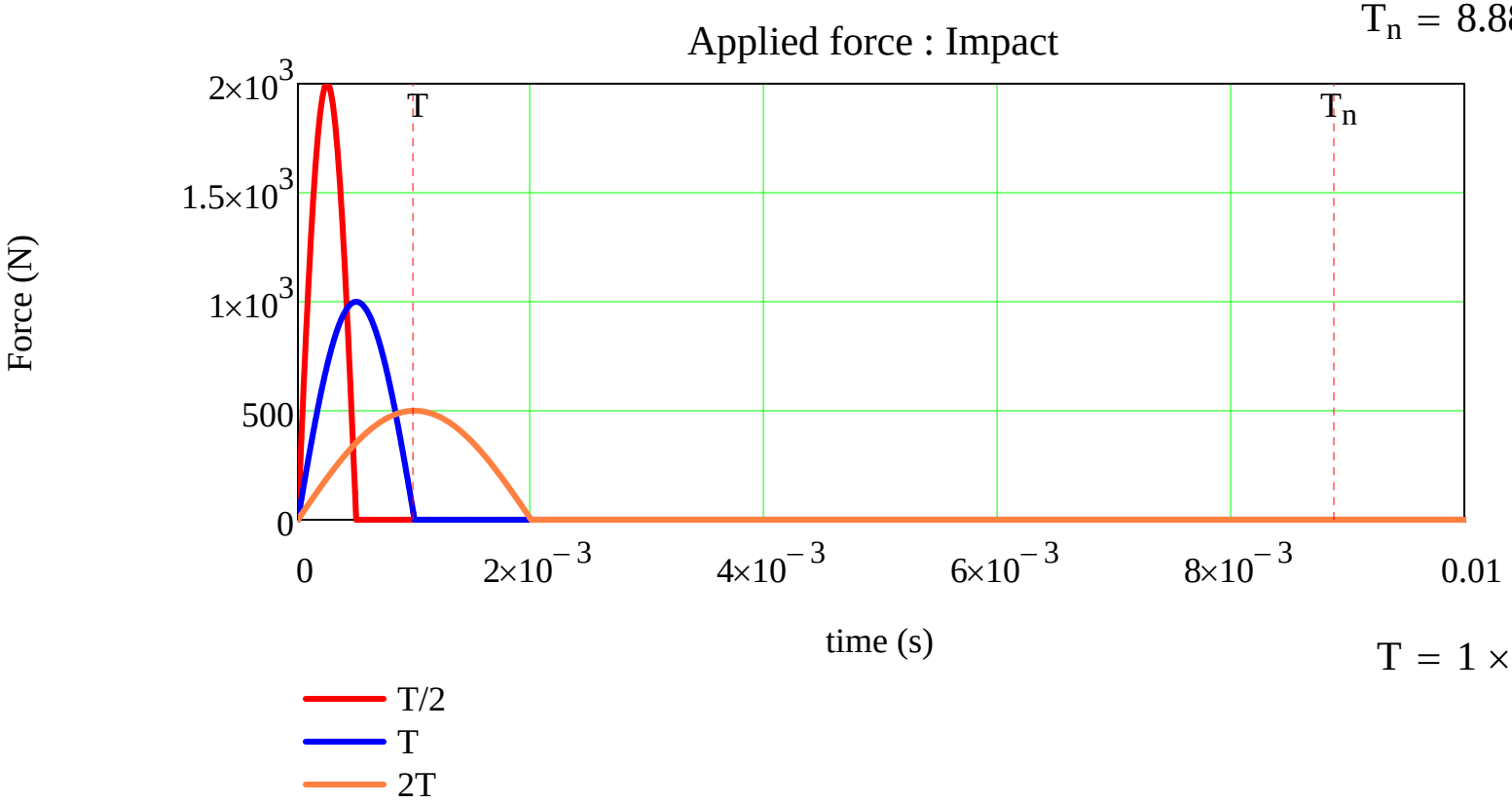
1 YES, 0: NO $Y_{window} := 0$

Sampling must be at least twice larger than 1/T

$$F(t,T) := \begin{cases} \dfrac{\text{Impulse}}{T\cdot\frac{2}{\pi}}\cdot\sin\left(\pi\cdot\dfrac{t}{T}\right) & \text{if } t < T \\ 0 & \text{if } t \geq T \end{cases}$$

$$\frac{T}{T_n} = 0.113$$

$$T_n = 8.886 \times 10^{-3}\,s$$



$$T = 1 \times 10^{-3}\,s$$

$$\frac{T}{T_n} = 0.113$$

window

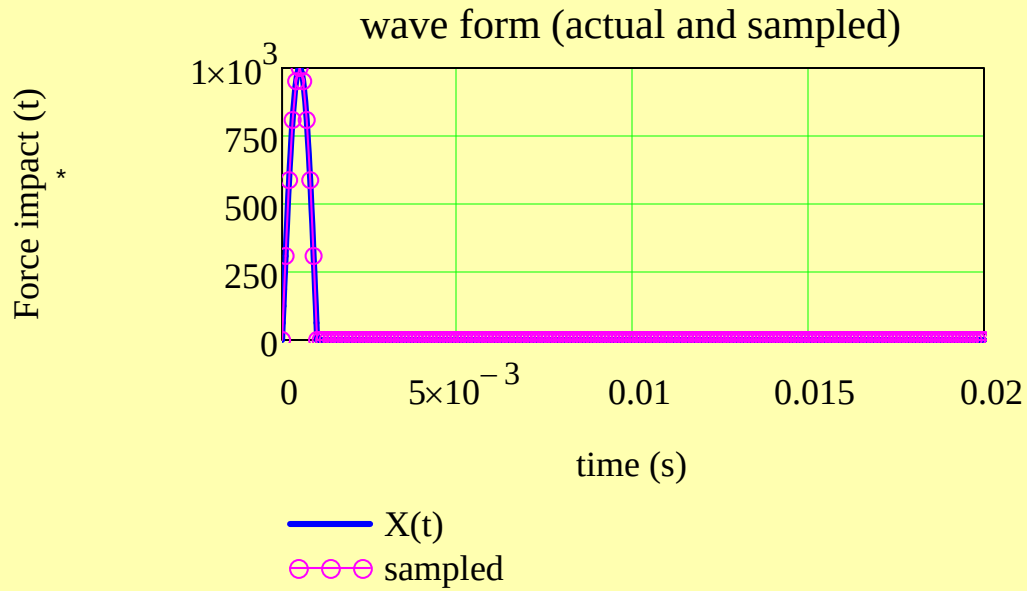
Select time-length of impact

$T_I := T$

$T_M := T_I \cdot 20 = 0.02\,s$

plot

Create function



$T_{max} = 0.102\,s$

$\frac{T_{max}}{T_I} = 102.3$

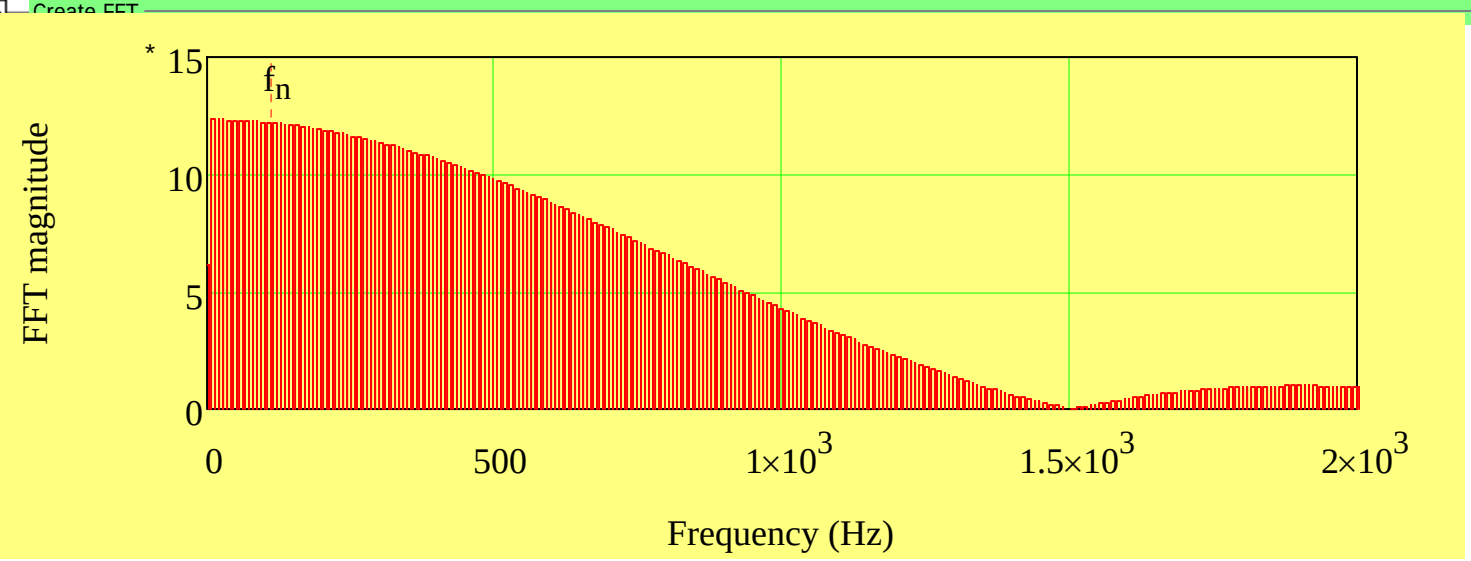
$\frac{T}{T_n} = 0.113$

$\frac{\Delta t}{T_I} = 0.1$

for graphs

$freq_{max} := 2000 \cdot Hz$

Create FFT



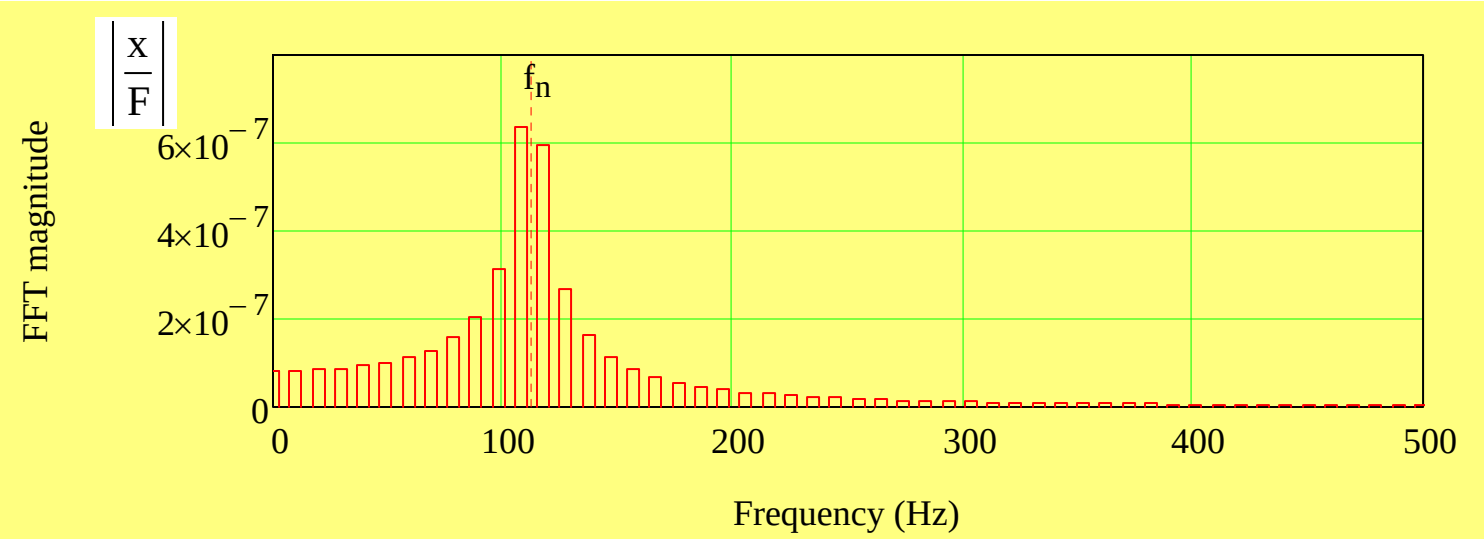
$\Delta f = 9.785 \cdot Hz$

$T_{max} = 0.102\,s$

R & I parts of FX

Build system response (frequency and time)

$A_{max} := \max(A) = 6.348 \times 10^{-7}\,m$

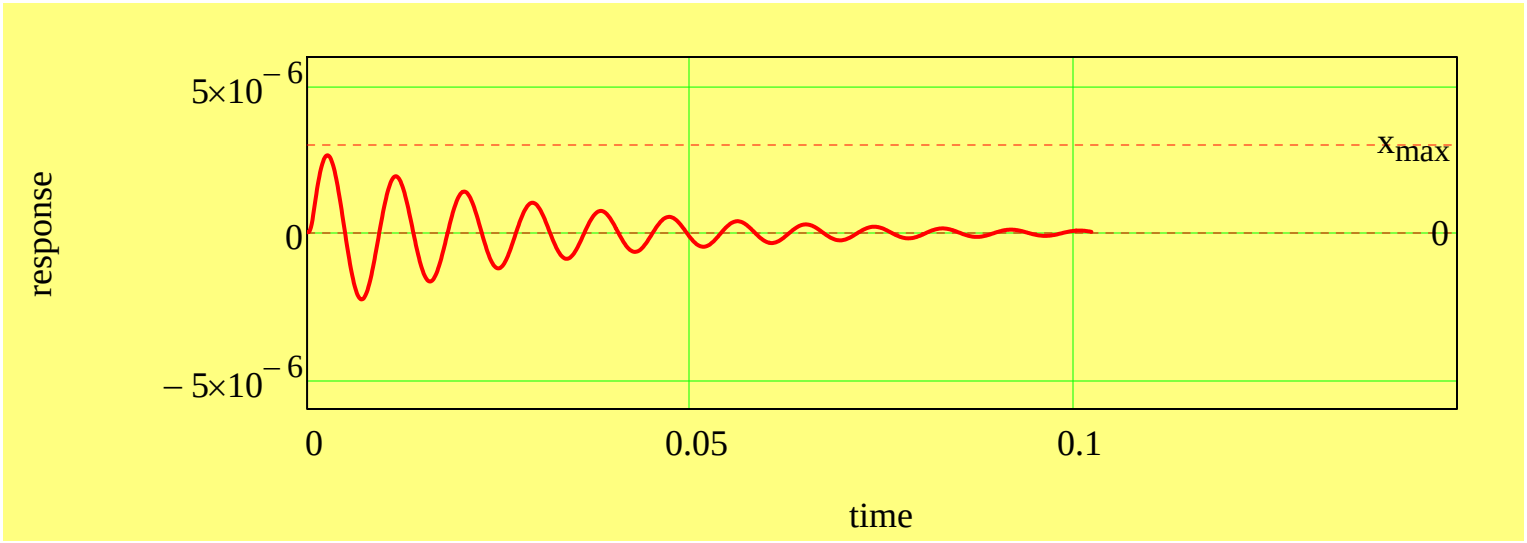


(b) Time response

$\max(X) = 2.649 \times 10^{-6}\,\text{m}$

$V_o := \frac{\text{Impulse}}{M} = 2.122 \cdot \frac{\text{mm}}{\text{s}}$

$x_{max} := \frac{V_o}{\omega_n} = 3.001 \times 10^{-6}\,\text{m}$



window

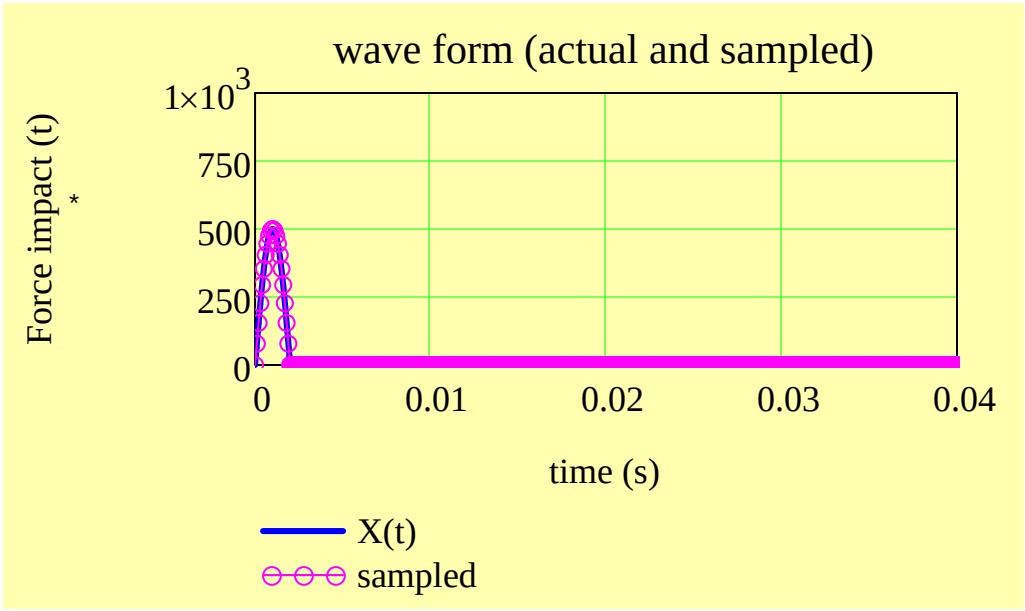
Select time-length of impact

$T_I := T \cdot 2$

$T_M := T_I \cdot 20 = 0.04\,s$

plot

Create function



$T_{max} = 0.102\,s$

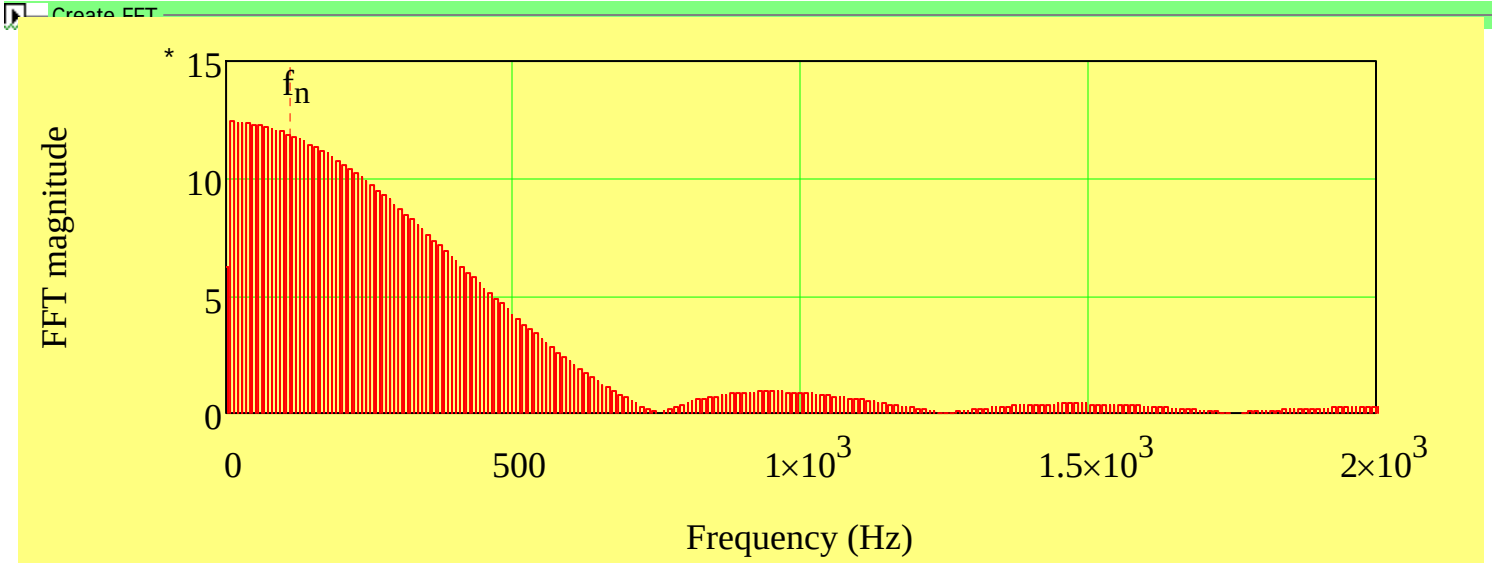
$\frac{T_{max}}{T_I} = 51.15$

$\frac{T}{T_n} = 0.113$

$\frac{\Delta t}{T_I} = 0.05$

for graphs $freq_{max} := 2000 \cdot Hz$

Create FFT



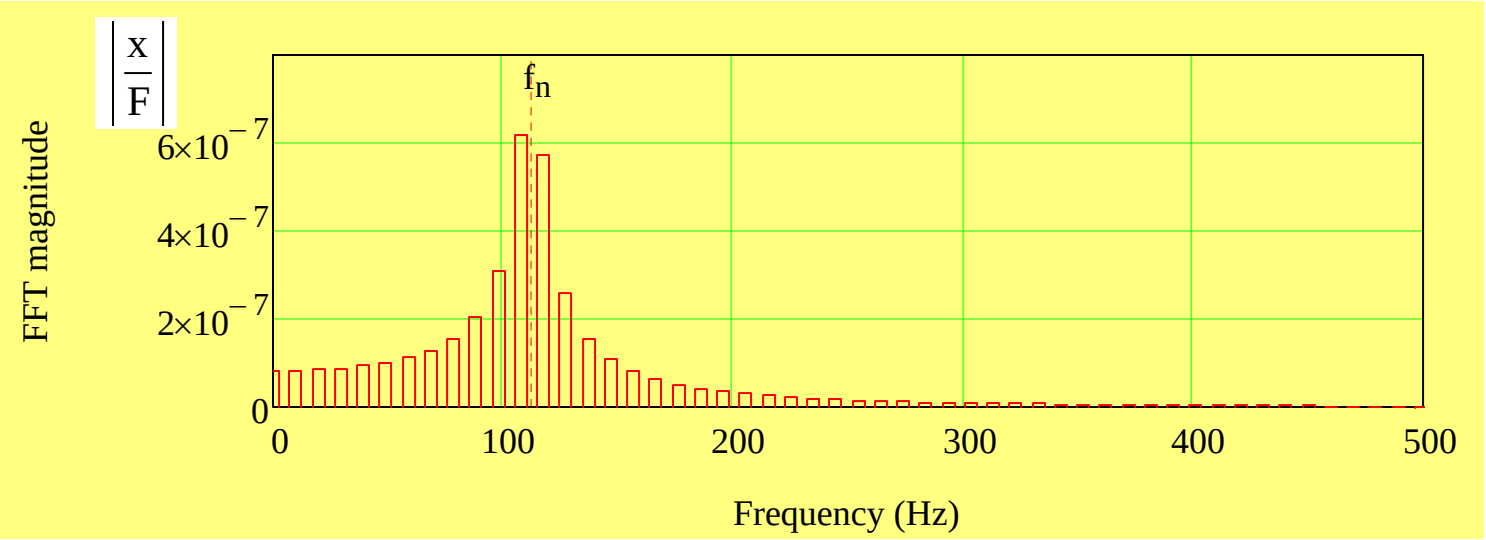
$\Delta f = 9.785 \cdot Hz$

$T_{max} = 0.102\,s$

R & I parts of FX

Build system response (frequency and time)

$A_{max} := \max(A) = 6.183 \times 10^{-7}\,m$

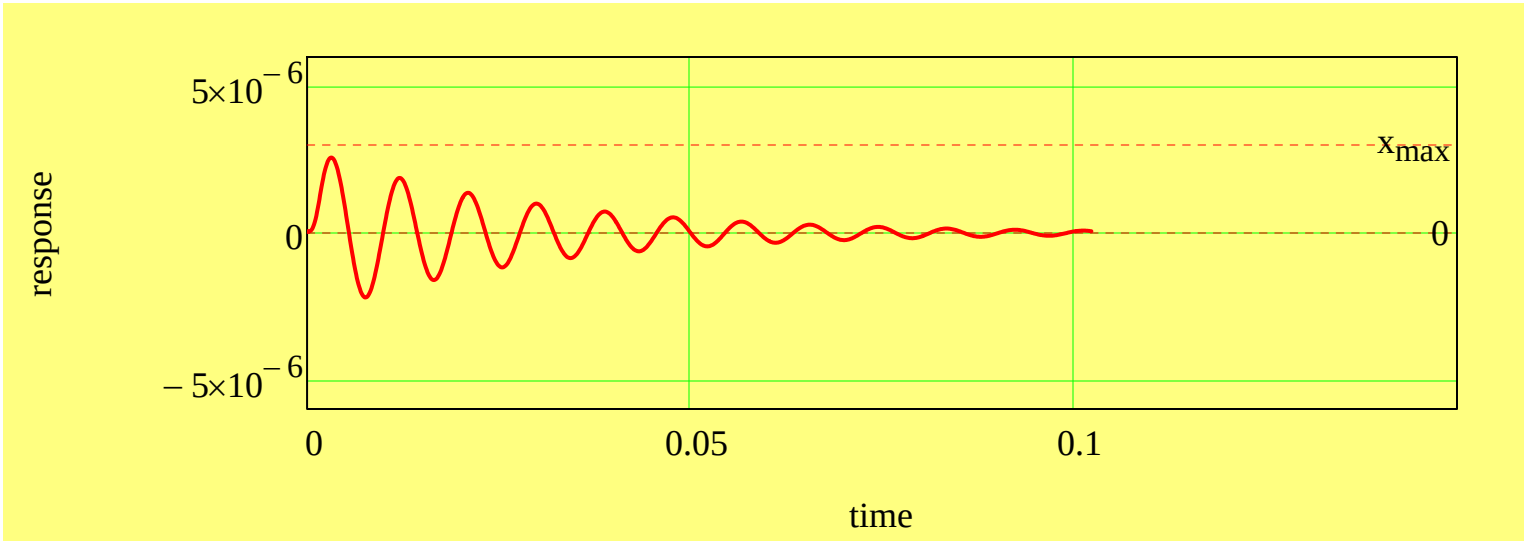


(b) Time response

$\max(X) = 2.573 \times 10^{-6}\,\text{m}$

$V_o := \frac{\text{Impulse}}{M} = 2.122 \cdot \frac{\text{mm}}{\text{s}}$

$x_{max} := \frac{V_o}{\omega_n} = 3.001 \times 10^{-6}\,\text{m}$



window

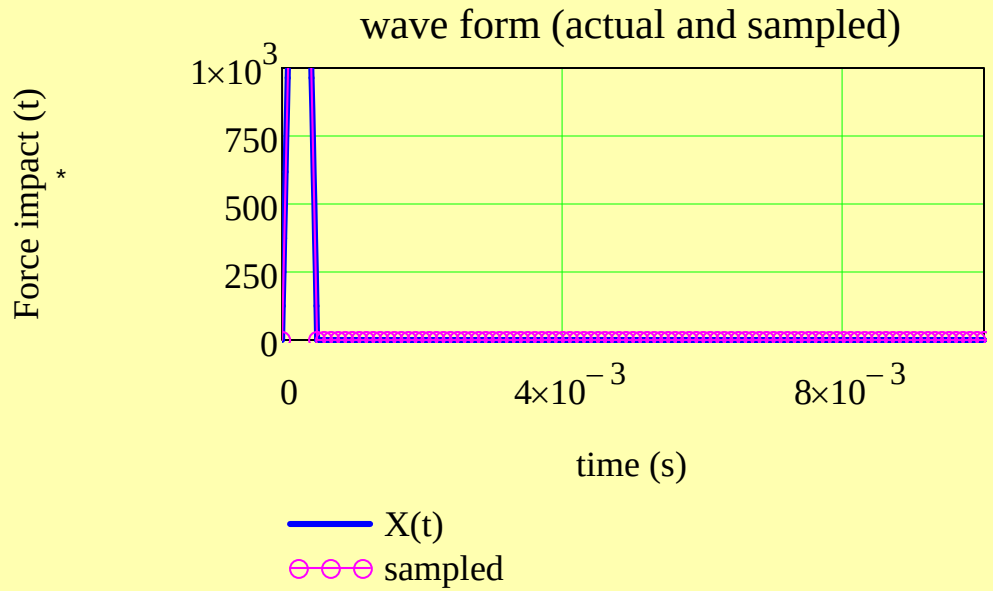
Select time-length of impact

$T_I := .5T$

$T_M := T_I \cdot 20 = 0.01\,s$

plot

Create function



$T_{max} = 0.102\,s$

$\frac{T_{max}}{T_I} = 204.6$

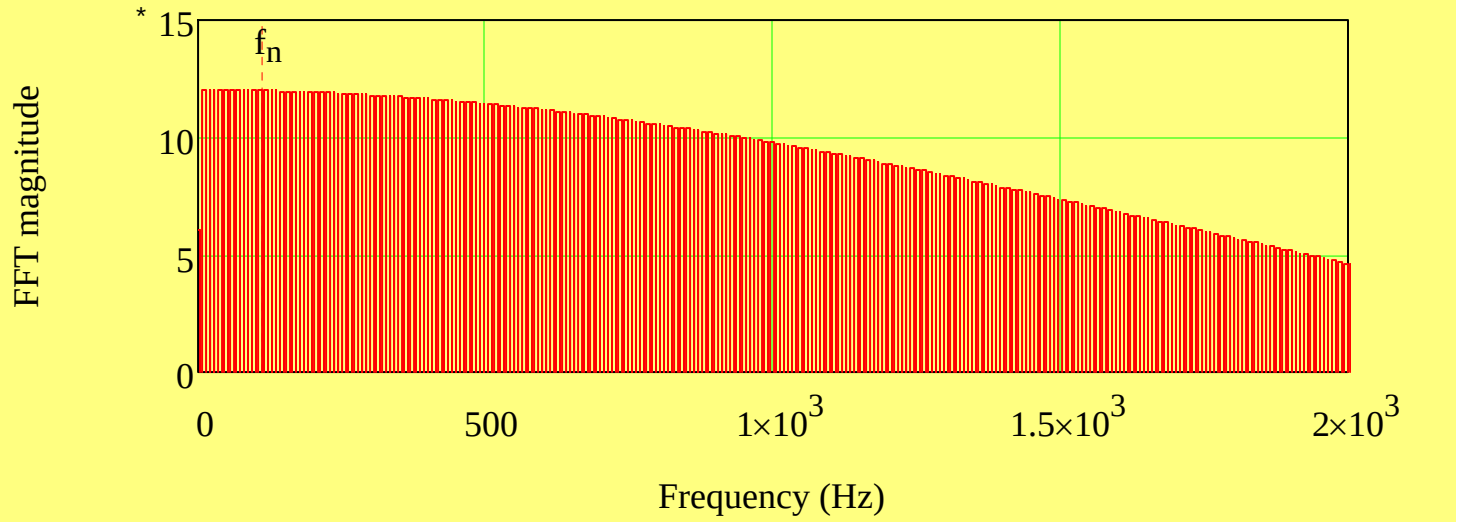
$\frac{T}{T_n} = 0.113$

$\frac{\Delta t}{T_I} = 0.2$

for graphs

$freq_{max} := 2000 \cdot Hz$

Create FFT



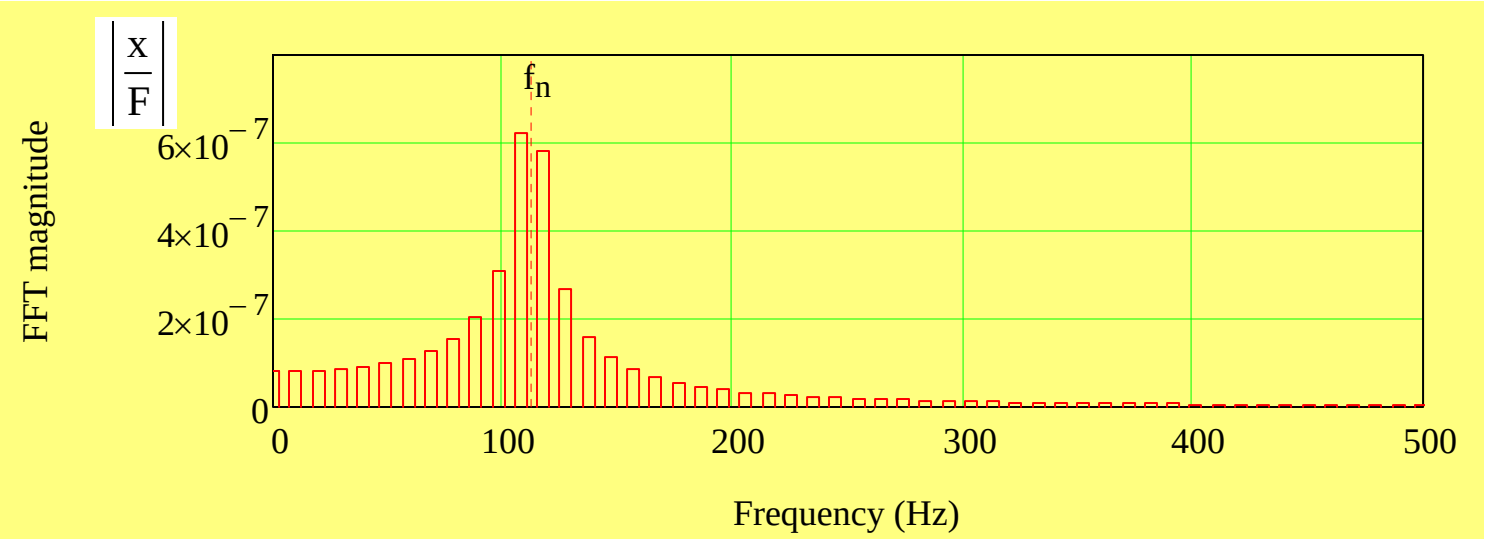
$\Delta f = 9.785 \cdot Hz$

$T_{max} = 0.102\,s$

R & I parts of FX

Build system response (frequency and time)

$A_{max} := \max(A) = 6.239 \times 10^{-7}\,m$



(b) Time response

$\max(X) = 2.607 \times 10^{-6}\,\text{m}$

$V_o := \frac{\text{Impulse}}{M} = 2.122 \cdot \frac{\text{mm}}{\text{s}}$

$x_{max} := \frac{V_o}{\omega_n} = 3.001 \times 10^{-6}\,\text{m}$