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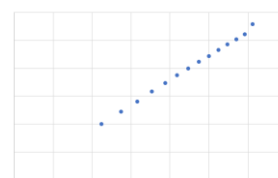
The investigation the effect of spring constant (k) on system's natural frequency (ω) under fixed conditions

1. The objective of this lab is to investigate the effect of spring constant (k) on system's natural frequency (ω) under fixed conditions.
2. The objective functional form of the lab is as shown in the table below.

Objective Statement	Objective Functional Form	Objective Graphical Representation
Investigate the effects of spring constant (k) on system's natural frequency (ω) under fixed conditions	$\omega = f(k; - ; m, A, f, x)$ Where: $\omega = natural\ frequency$ $k = spring\ constant$ $m = mass$ $A = sine\ wave's\ amplitude$ $f = sine\ wave's\ frequency$ $x = mass's\ initial\ position$	

3. Experimental conditions and scope

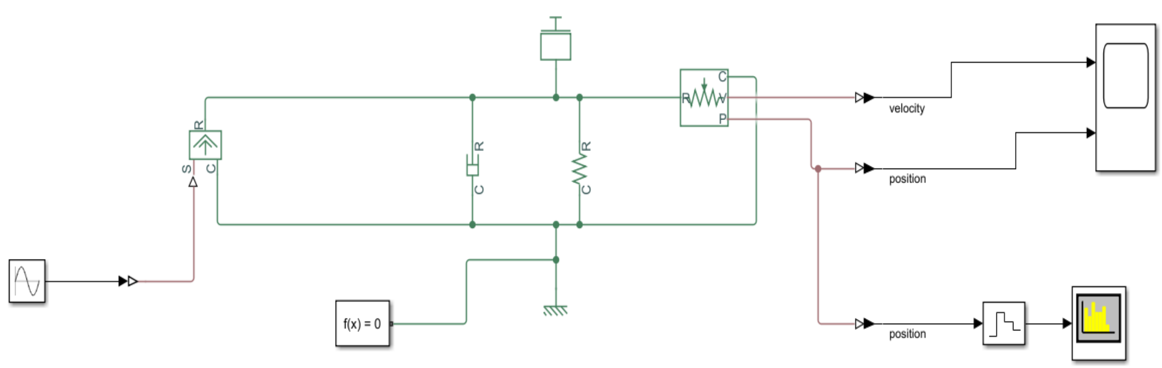
   Varied parameter:

   $$Spring\ constant\ (k): 20 \le k \le 150\ (\Delta k = 10\frac{N}{m})$$

   Fixed parameters:

   $Mass\ (m): 20\ kg$
   $Sine\ wave's\ amplitude\ (A) = 200$
   $Sine\ wave's frequency\ (f) = 100\ hz$
   $mass's\ initial\ position\ (x) = 0\ m$

4. To do such task, MATLAB Simulink program is needed to simulation the system of mass-spring damper as shown below.



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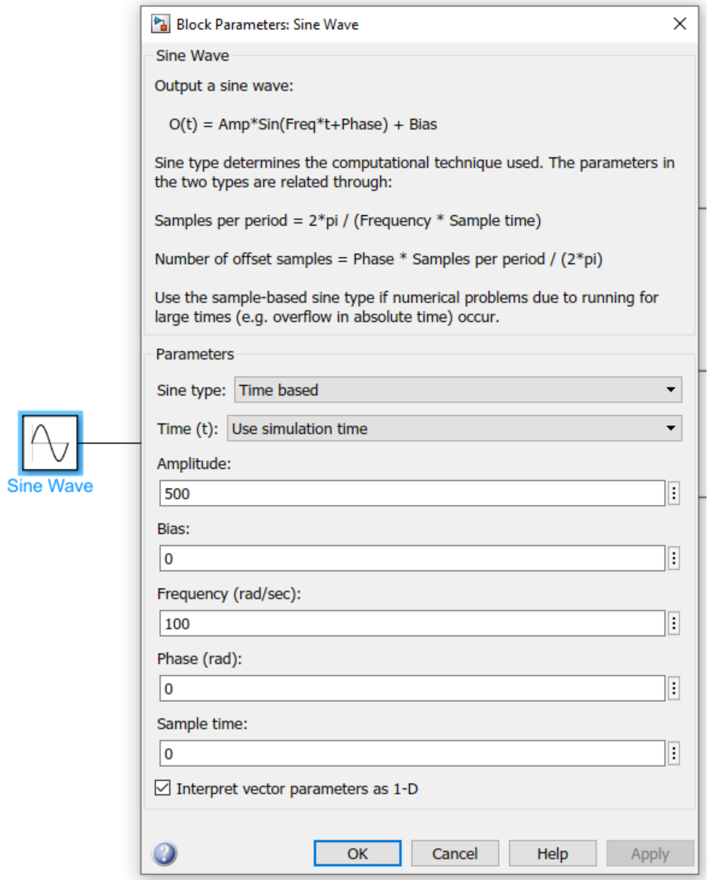
5. The system consists of sine wave block (used to generate sine wave), ideal force source (used to generate force), spring, damper, ground reference, ideal translational motion sensor, and a mass. The output of the system are position and velocity of the point mass which are monitored by scope.
6. The setting of the initial system is as followed: Sine wave (amplitude of 500, frequency of 100 $\frac{rad}{s}$), damping coefficient of 0 $\frac{N}{m/s}$, spring constant of 20 $\frac{N}{m}$, and initial position of 0 m.



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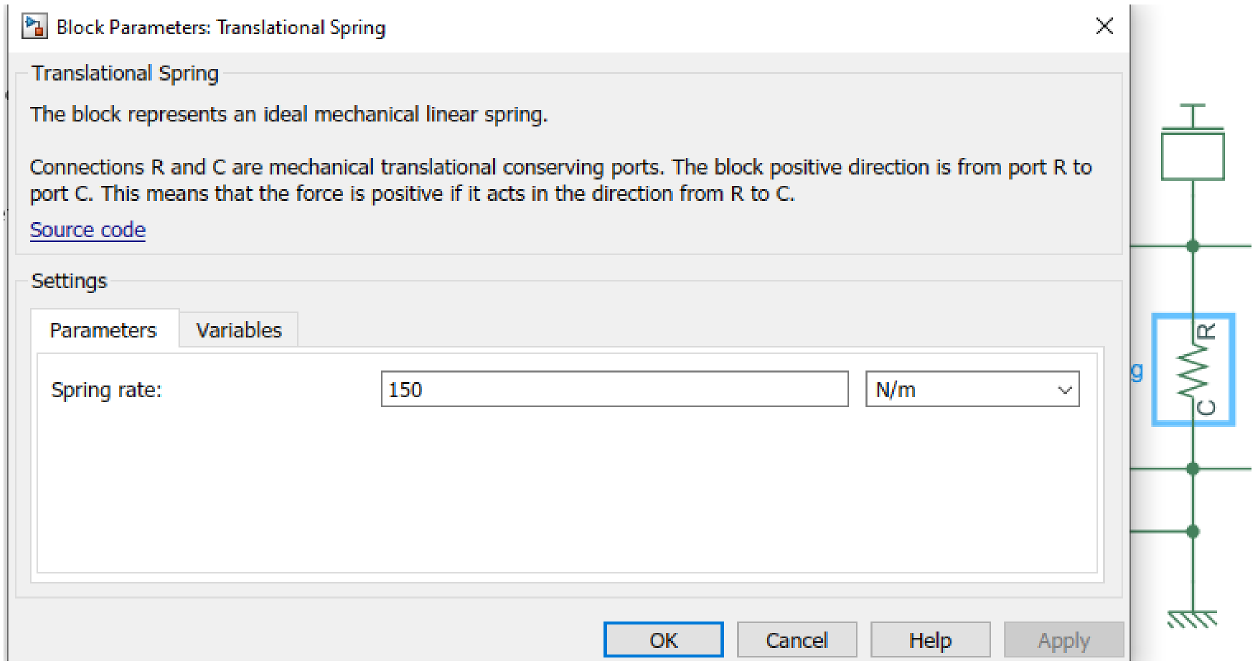

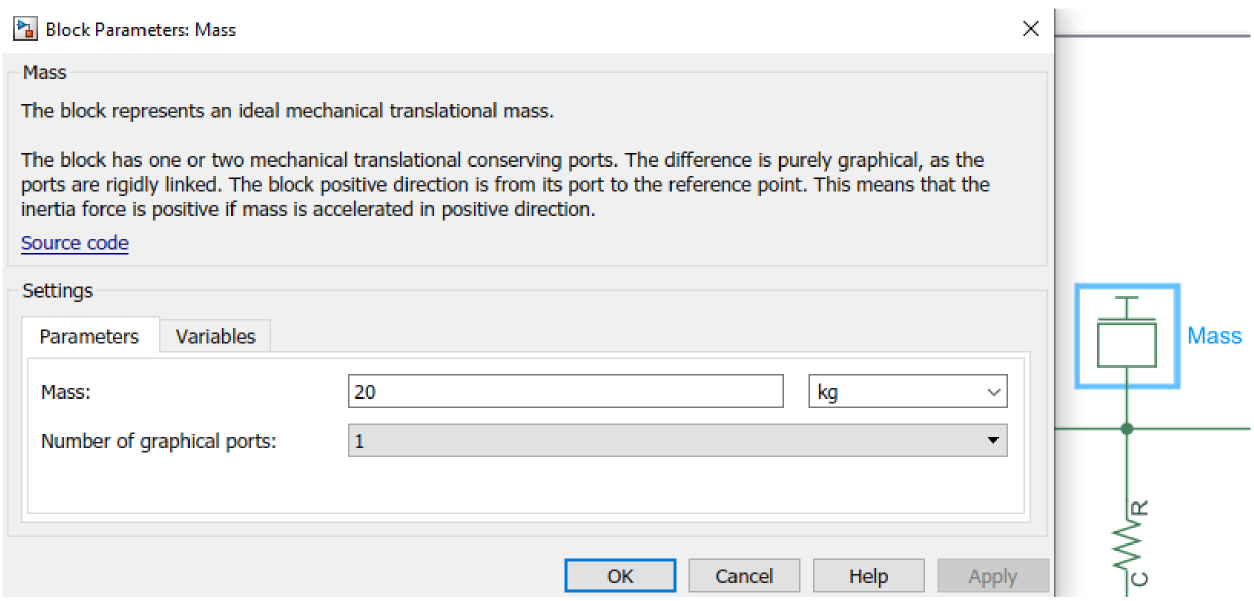

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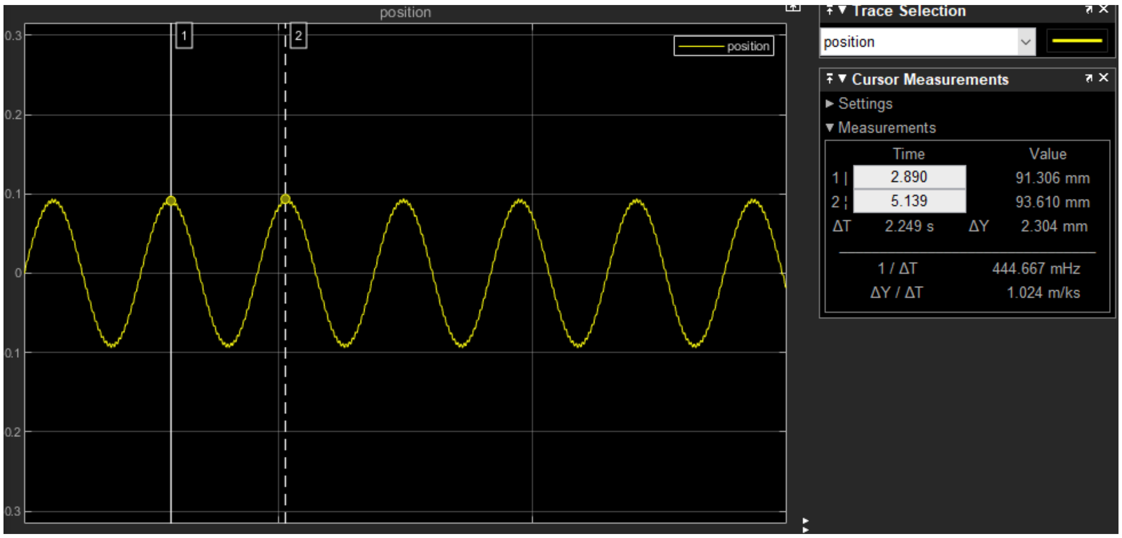
7. In scope, the graph can be seen in the figure below.



8. The different in time between peaks can be determined from the graph using cursor measurements tool.
9. Then, the spring constant (k) is varied from 20 to 150 $\frac{N}{m}$.
10. The data is then processed in Excel as shown in table below.

mass	20	kg	hz to rad/s	6.283185	
sine wave frequncy		100	rad/s		
k	sqrt(k)	delta T (s)	freq (hz)	scope freq (rad/s)	cal nat freq (rad/s)
20	4.472	6.297	0.159	0.998	1.000
30	5.477	5.127	0.195	1.226	1.225
40	6.325	4.475	0.223	1.404	1.414
50	7.071	3.958	0.253	1.587	1.581
60	7.746	3.621	0.276	1.735	1.732
70	8.367	3.351	0.298	1.875	1.871
80	8.944	3.148	0.318	1.996	2.000
90	9.487	2.969	0.337	2.116	2.121
100	10.000	2.834	0.353	2.217	2.236
110	10.488	2.699	0.371	2.328	2.345
120	10.954	2.586	0.387	2.430	2.449
130	11.402	2.496	0.401	2.517	2.550
140	11.832	2.406	0.416	2.611	2.646
150	12.247	2.249	0.445	2.794	2.739

Where the calculated natural frequency is determined using the equation below.

$$\omega = \sqrt{\frac{k}{m}}$$