

Spring-mass-damper simulation

The spring-mass-damper simulation is an example simulation and not explicitly a part of any course. The simulation represents behavior of a spring-mass-damper system, which is a second order dynamic system commonly used as example in different courses. It consists of a mass object hanging from a spring and a damper. This simulation was originally created as a testing tool for the simulator program's solver and graphing capabilities, but it was left into the program for its potential as a learning tool.

The simulation can be opened from the simulator's startup menu and the opening view is similar to figure 1. The basic controls of the simulation are explained in the user manual.

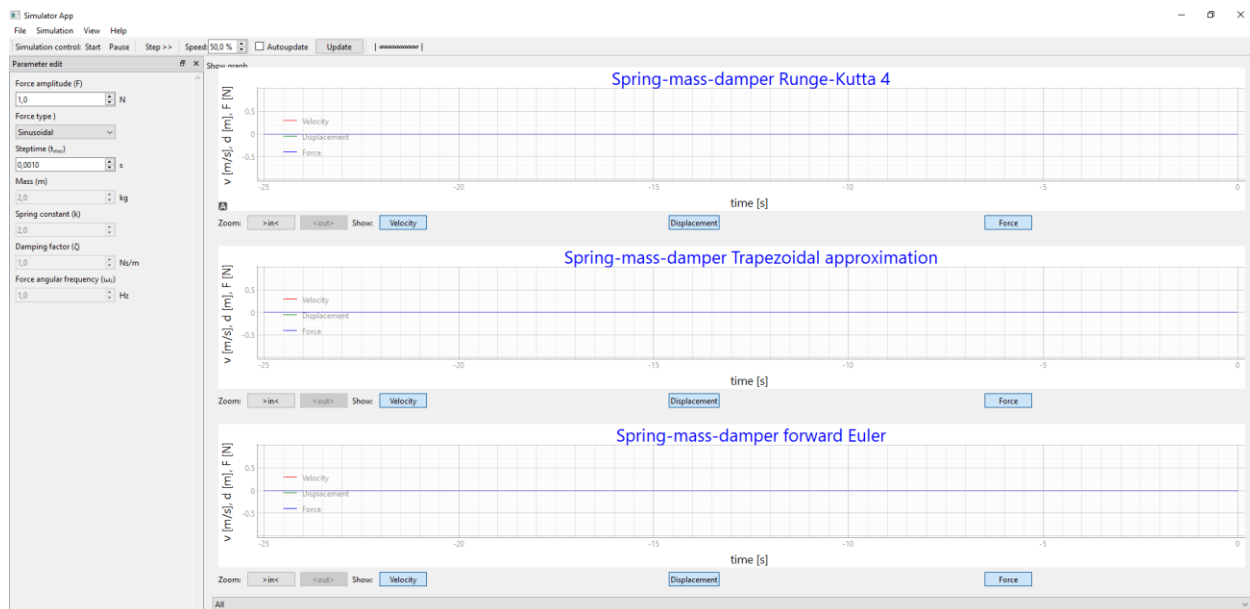


Figure 1. Simulation view of Spring-Mass-Damper simulation.

The simulator view consists of three time-domain graphs and one dropdown menu. The time-domain graphs show the behavior of the spring-mass-damper (SMD) system when a force is applied to it. Different graphs show the results of the same system solved using a different method. If comparison between different methods is not required, can all but one graph be removed by using the dropdown menu. Each graph shows the force applied to the system, and the displacement and velocity of the mass.

The simulation is done using Runge-Kutta 4, trapezoidal and forward Euler methods. These methods can be used to solve linear systems. When the simulation is started there is a sinusoidally varying force applied to the mass, which is initially stationary. The main user inputs are force amplitude and force type changes. Force type can be changed to sinusoidal or static force. The system's constants including mass, spring constant and damping factor can be changed and the angular frequency of the applied force. Additionally, the simulation step time can be changed for comparison between the solver methods. The goals of this simulation are to be used as SMD system demonstration and demonstration of solver methods. The editable simulation parameters are expanded on table 1.

Table 1. Parameter edit parameters, symbols, units and definitions.

Parameter	Symbol	Unit	Definition
Force amplitude	F	N	Amplitude of input force, if force type is static, this is the given force
Force type	-	-	Selection between sinusoidal input force and static input force
Step time	t_{step}	s	Simulation step time
Mass	m	kg	Mass of the SMD system
Spring constant	k	-	Spring constant of the SMD system spring
Damping factor	ζ	Ns/m	Damping factor of the system
Force angular frequency	ω_F	Hz	Angular frequency of the sinusoidal input force