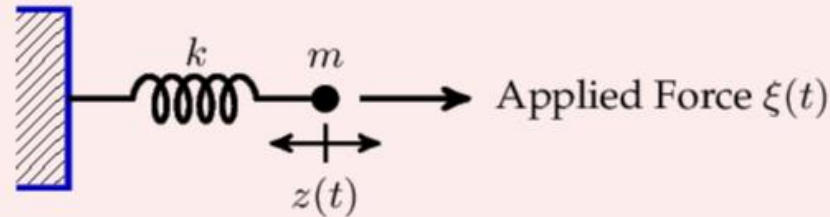


Example 4.2: Correlation Lag — Mechanical System

Let us consider the example of an oscillating mass m on a spring k , an example to which we will return in some detail in **Case Study 5**:



Suppose we had measurements of the applied force ξ , and we had an accelerometer and visual camera measuring the acceleration \ddot{z} , the velocity \dot{z} , and the location z of the mass. What might we expect to see?

We know that

$$\ddot{z} = \frac{\xi - kz}{m} \quad \dot{z} = \int \ddot{z} + c_1 \quad z = \int \dot{z} + c_2 \quad (4.20)$$

Although there is an instantaneous relationship between force ξ and acceleration \ddot{z} , the inertia of the mass leads to a lag between force and velocity \dot{z} or position z , as made clear in the simulation:

