Diagram

Description automatically generatedConsider the mass in a spring-mass system. Newton’s law says,

where and .

Note that these are vectorial equations; are each vectors with an x- and y- component.

If we assemble the masses into a (block) matrix equation, we have:

where are the stacked vectors , is the vector of stacked ’s, and accounts for the forces from the two fixed endpoints (derivation not shown here).

It’s not very obvious from the above equation, but is a diagonal matrix of the node masses and thus doesn’t change with time. On the other hand, is a tri-diagonal matrix comprising the spring coefficients and elongations, . Since depends on , also depends on and is therefore time-dependent.