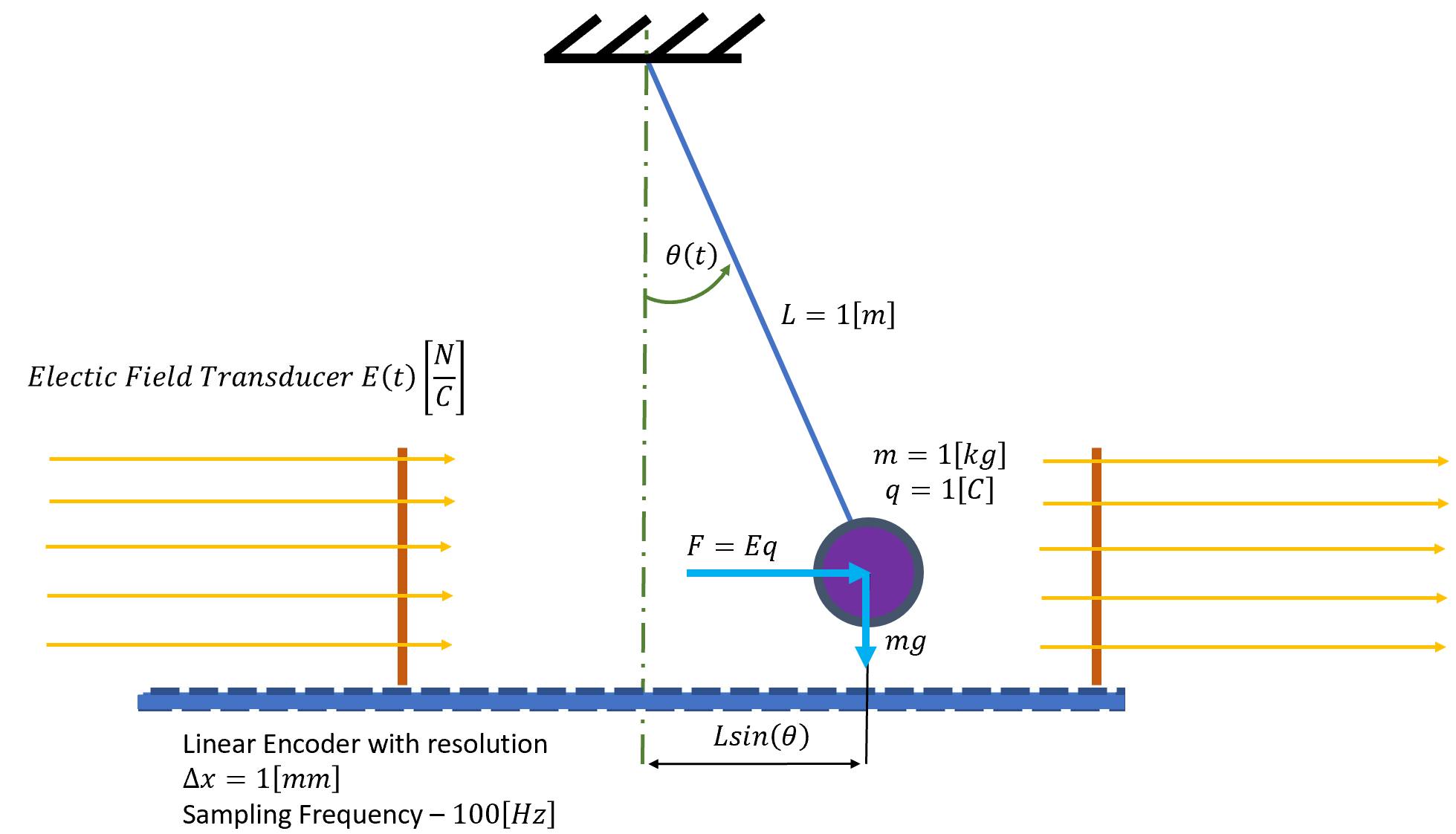
Kalman Test on a basic Pendulum System

# Problem Introduction

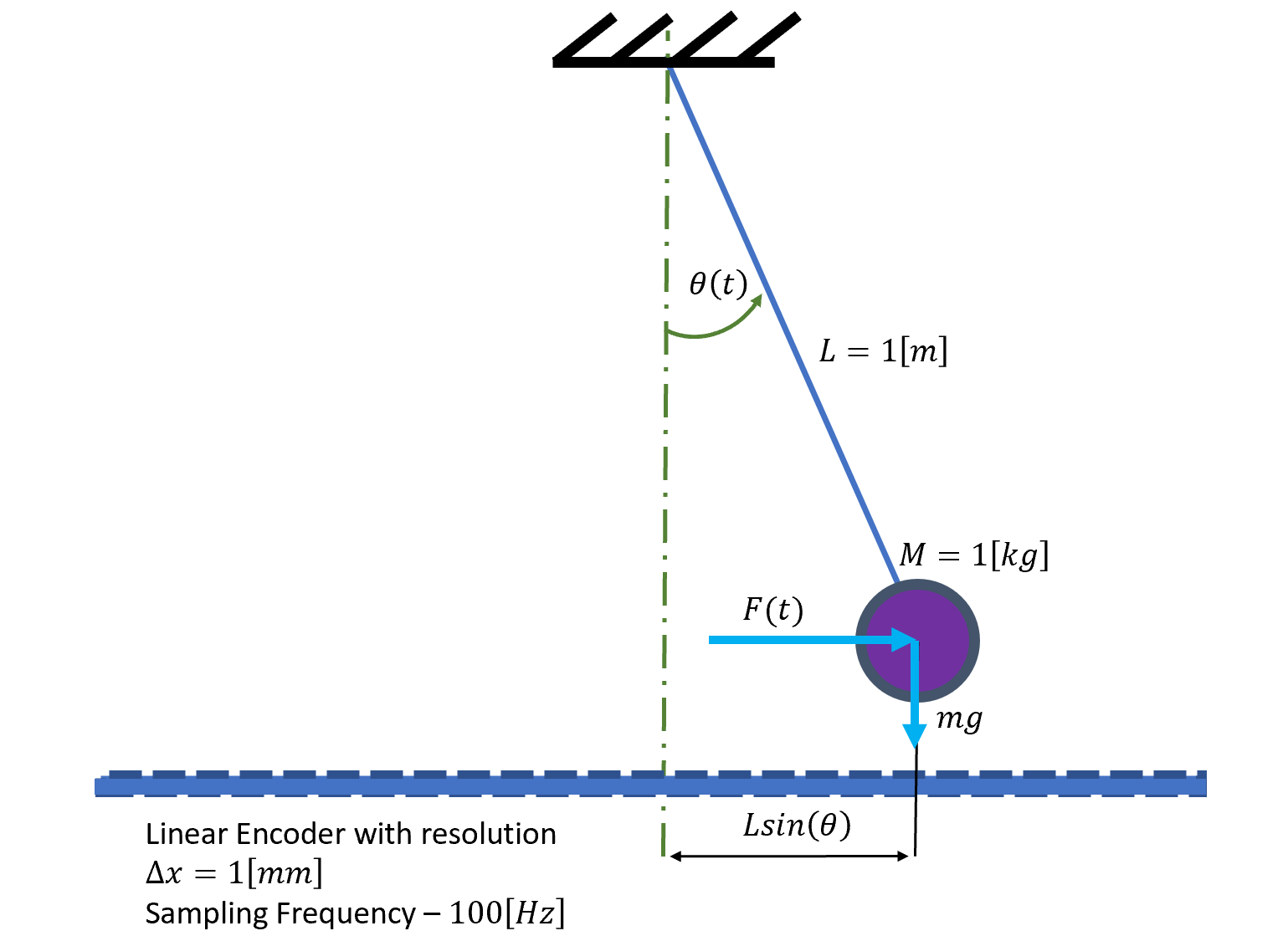
Let us imagine a pendulum system of a charged bulb exited by an initial drop from an initial state and an electrical field controlled by a scientist.  
To measure the state of the system, an linear encoder was placed undeath the charged mass with a resolution of .

**How accurately can we estimate the state of the system using a dynamic model and the measurements?**

**Bonus:  
What electric field should the scientist input for every initial state if his objective is to bring the bulb to a halt as quickly as possible?**



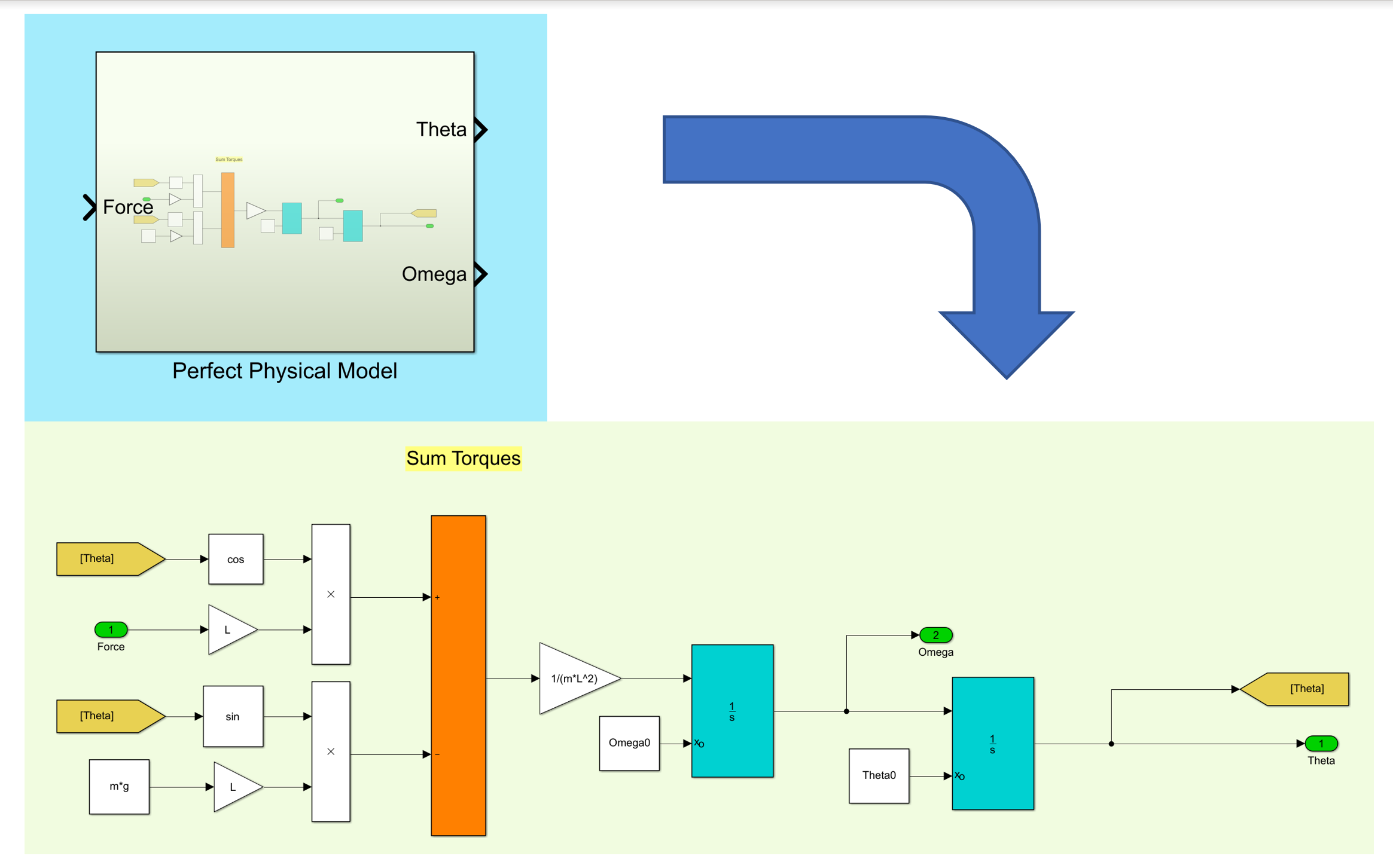
To simplify things, let us work with a dumbed down system where the force is directly controlled by the scientist rather than the electrical field.



# Dynamic Model Derivation

Using Newton’s second law:

In Simulink:



Sanity Test:

For and a small initial a natural frequency. The system will oscillate about a natural frequency.  
Let’s drive it:

Small initial allows for small angle approximation

Solving the ODE:

Substituting numbers in:

The period of the system: