Math Capstone Project

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Case 1.1 We consider the system $m\ddot{x} = -\gamma\dot{x}$ (1.1.1). In such a system, the acceleration $\ddot{x}$ is negatively correlated with the velocity $\dot{x}$ with a coefficient, $-\gamma/m$. The opposite sign between $\ddot{x}$ and $\dot{x}$ indicates the deceleration. Imagine a particle moving on a frictional surface. The inertia, which is proportional to the self-mass, drives the particle moving forward while the frictional force drags the particle backward and attempts to stop the particle's forward motion. That explains why m appears on the fraction's denominator to compensate for the opposite effect brought by γ. From the above description, we recognize that frictional force is the only force applied to this system; inertia is not a force. We can also conclude the same result by comparing the classical Newton's second law, $F = ma$ with the equation (1.1.1), which gives $F = -\gamma\dot{x}$. By observing the coefficient, we again concluded that the frictional force is the only contributing force in our system. We, thus, call such a system overdamped to reflect the high energy loss caused by the frictional force.

$$m\dot{p} = -\gamma p$$