

# Bouncing Ball Problem

MATLAB Refresher

# Problem Description

- A ball falls freely from a height of 1m from the ground with a zero initial velocity.
- It is assumed that the ball makes inelastic collision with the ground and loses some of its energy every time it strikes the ground.
- The coefficient of restitution (COR) is 0.7 i.e. the velocity of the ball after colliding with the ground will be in opposite direction (as it bounces back) and the magnitude will be decreased by 0.7 times.
- Simulate the temporal changes in height of the ball until it stops bouncing.

# Sign of the variables

- The direction of the velocity towards the ground (negative  $y$  axis) is assumed to be negative.
- The direction of the velocity towards the sky (positive  $y$  axis) is assumed to be positive.
- Similarly, the acceleration due to gravity is assumed to be negative as it acts always towards the ground.

# Important variables

- $u$ =initial velocity at the beginning of a time step or the velocity from previous time step
- $v$ =final velocity after a time step
- $g$ = acceleration due to gravity
- $e$ =coefficient of restitution
- $h_0$ =initial height of the ball
- $dt$ = time step size

# Governing Equations

$$v = u + g \cdot dt$$

$$h = u \cdot dt + \frac{1}{2} g \cdot dt^2$$

$$e = 0.7$$

$$g = -9.8$$

$$h_0 = 1$$

# Hint

- Define a time step size (in every time step the new velocity and the new position or height of the ball will be calculated)
- Construct a for loop which runs over time.
- New velocity and height is calculated inside this loop.
- End time may be taken as 2.5 seconds.
- Time step size may be taken as 0.01 seconds.