Recommended Assessment

Balance Control

Exploring Energy Control

1. When manually rotating the pendulum with ke = 0, what do you see as the pendulum is moved? Attach a screenshot of the *Pendulum (deg)* and *Pendulum Energy (mJ)* scopes when the pendulum is rotated into the upright position. What is the pendulum energy in this position?

2. Does the pendulum energy measured above align with equation for the potential energy of the pendulum?

$$E_p(t) = m_p g l(1 - \cos(\alpha))$$

3. When varying the reference energy, E_r, between 10.0 mJ and 20.0 mJ, attach a screenshot of the *Pendulum (deg)*, *Pendulum Energy (mJ),* and *Vm (V)* scopes that represents the behaviour of the system when the reference energy is increased. How does increasing the reference energy, E_r, affect the system response?

4. When fixing E_r to 20.0 mJ and vary the swing-up control gain ke between 20 and 60 m/s^2/J, attach a screenshot of the scopes that represents the behaviour of the system when ke is increased. How does increasing ke affect the system response?

Hybrid Swing-up Control Implementation

5. When setting E_r based on previous calculations and gradually increasing the swing-up gain, ke, to get it to balance, attach a screenshot of the scopes demonstrating the swing-up and balancing behaviour. What was the swing-up gain required to swing-up and balance the system?