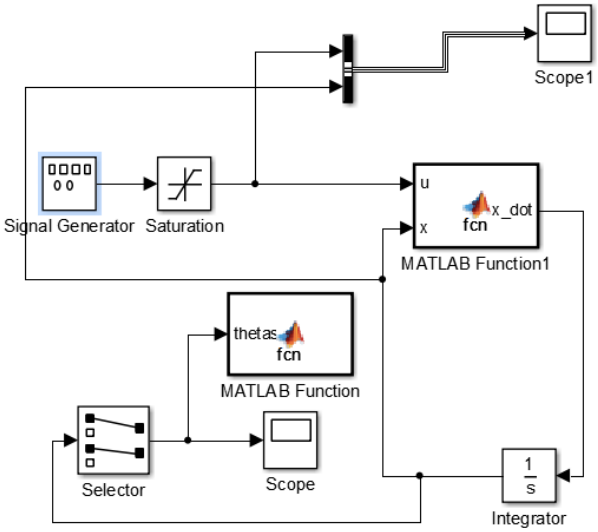
FL. 2018 ESE 447.02 Robotics Lab

Lab Journal 10

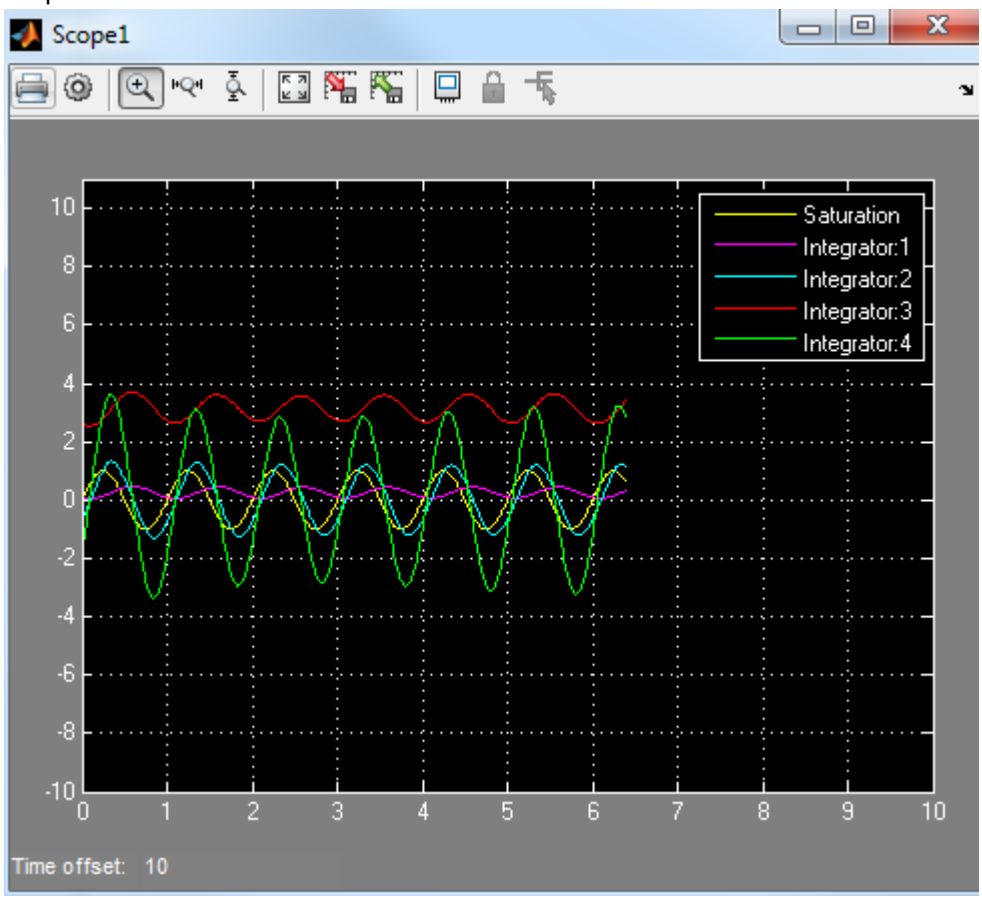
10/7/2018

1. Complete the dynamic simulation
   Based on the model built in last lab, we were able to simulate the two-link system by giving it an initial position to the integrator. The initial position is slightly past the 0 position so that the second link that points upward can swing down due to gravity that we gave to the system.
   We also tried giving the voltage for the motor of the first link.



As shown in the picture above, we added a signal generator to create a sine wave, and a saturation block to saturate the signal in case the amplitude goes too high. We observed the saturated input signal and the feed-back signal, where the feed-back signal is also the

output state of the simulation.



As shown above, the yellow signal is the saturated input, the other lines are the state variables q1, q1_dot, q2 and q2_dot from integrator 1 to 4, respectively.

2. We played with the model by letting the second link fall freely from its initial position, giving the integrator a small tilt from the vertical direction. The second link behaved like a real metal rod with mass, gravity and friction, and it dragged the first link to oscillate as well until it finally stopped due to energy loss in the process.
   We also tried changing the 6 theta values to see how they affected the behavior of the system.
   (1) Increasing θ_1: when $\theta_1$was increased, the first link seemed to have more inertia so it got less dragged by the second link.
   (2) Increasing θ_2: when θ_2 was increased, the second link seemed to have more inertia so it fell slower at the start and had a larger amplitude of swinging.
   (3) Increasing θ_3: when θ_3 was increased, the first link tends to move more easily, when it was 0, link 1 did not move at all. But when θ_3 was too high, some error would occur and the system went crazy.
   (4) Increasing θ_4: when θ_4 was increased, the pendulum motion of the link2 seemed to have a higher frequency and it came to a stop more quickly.
   (5) Increasing θ_5: when θ_5 was increased, link1 tended to have more friction at the joint so it rotated less easily.
   (6) Increasing θ_6: when θ_6 was increased, link2 tended to have more friction at the joint.

3. Comparing the real system with the simulation
   It was noted that the simulation had a 0 position with the link2 pointing upward, and the real system had a 0 position with link2 pointing downward. Therefore a bias of 180 degree should be considered when comparing the real system and the simulated system. Since we got a general idea of how the theta values impact on the simulation, we could change the theta values to make the simulation more similar to the real system.