Task 3

* Explain how calls to DOP853 and update\_edl\_state work together to simulate the appropriate physics regime as the system goes through its different operational phases (parachute only, firing rockets, etc.).
* Create a flowchart or other illustration to support your explanation.

The simulation loop runs until TERMINATE\_SIM becomes “true”, or until an event occurs. Variable ‘fun’ is assigned to the dy/dt vector based on input variables ‘t’ and ‘y’. The dydt vector holds information about the EDL acceleration, EDL velocity, change of total mass of rocket due to propellant expelled, error of EDL velocity, error of EDL position, rover acceleration, and rover velocity.

From the scipy.integrate module, solve\_ivp is imported to solve the ordinary differential equation. DOP853 is an 8th order explicit RK method; its step size is controlled (to 0.1) to help with accuracy.

The EDL has 9 (zero through eight) phases:

0. Reached altitude to eject heat shield

1. Reached altitude to eject parachute

2. Reached altitude to turn on rockets

3. Reached altitude to turn on crane

4. Out of fuel --> y(3)<=0. Terminal. Direction: -1.

5. EDL System crashed at zero altitude

6. Reached speed at which controlled descent is required

7. Reached altitude at which position control is required

8. Rover has touched down on surface of Mars

The update\_edl\_state function specifies the initial conditions for each phase of the EDL. The physics simulation is different for each phase so the IVP must iterate though each phase.