Assumption on rover dimension and position of arm within rover:

Rover is about 1.2m wide, and length doesn’t matter…but probably 1.5 m

The wheel width is about 20cm. The important point is, we have about 70cm width between left and right wheels to work with. The chassis is lifted off ground by at least 10 cm, probably 15. This helps rover to get over obstacles, and also gives us space to place the arm.

Arm will be anchored beneath the vehicle, 5 cm to the **right** of **left** forward wheel, 5 cm from forward edge of rover, 5 cm from ground.

Actually the anchor is not stable because the rocker-bogie bounces, so the rover’s chassis bounces with it. But as a first approximation we assume the base of the arm to be stable, thus uses it as ground. Later we may need to model the rocker-bogie spring as well.

Model’s Orientations:

Forward: positive x.

Upward: positive y.

Right: positive z.

(left handed system, but Matlab uses it)

Joint 1: Anchor to neck piece

1 DOF, rotate about y-axis

Curled up position: theta = 90.

Forward position: theta = 0.

Range of motion: 90 ~ -60 (limited by the presence of left forward wheel)

Neck piece: shape in model is cylindrical, 10 cm, 5 cm diameter.

Joint 2: neck to upper arm

1 DOF, rotate about z axis

Curled up position: theta = 0.

Pointing straight forward: theta = 0

Pitching upward: theta > 0.

Range: 0 – 75

Upper arm: shape in model is cylindrical. 40 cm, diameter 5 cm

Joint 3: upper arm to lower arm

1 DOF, rotate about z axis

Curled up position: theta = 0.

Straight forward: theta = 0.

Bent down: theta < 0

Range: 0 -180

Lower arm: shape in model is cylindrical. 40 cm, diameter 5 cm

Joint 4: lower arm to manipulator

1 DOF, rotate about z axis

Curled up position: theta = 0.

Range: 360 deg rotation.

Manipulator: cylindrical, length 15 cm, center of mass attached to lower arm.

Material:

In reality: use 2 parallel beam instead of cylinder, to save mass. Apparently Darren said that saving just a little bit of mass saves a LOT of money in this context.

Maximum forward reach from underpinning of arm to reference position (tip of drill, when contracted) 127.5 cm

I will refine some specs as I go on, according to what the mars rover manual said.

Material:

Carbon fiber: Fiber-reinforced materials such as carbon, aramid and glass composites have the highest strength and stiffness-to-weight ratios among engineering materials. For demanding applications such as spacecraft, aerospace and high-speed machinery, such properties make for a very efficient and high-performance system. Carbon fiber composites, for example, are five times stiffer than steel for the same weight allowing for much lighter structures for the same level of performance. In addition, carbon and aramid composites have close to zero coefficients of thermal expansion, making them essential in the design of ultra-precise work stations.

1.78 g/cm^3.

Links are hollow cylinders made of carbon fiber.

So the total mass of the arm is around 4.5kg + weight of sensors and actuators.

This is very light weight.