QEA2

Bridge of Doom

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Methodology

We first examined the given parametric equation:

$$r(u) = 0.3690 * cos(2.65(u + 1.4))i - 0.99 * sin(u + 1.4)j$$

To generate the left and right wheel velocity commands, we first mathematically defined the linear velocities of the NEATO by differentiating the parametric equation

$$ri = (0.3960 * cos(2.65 * (0.1 * t + 1.4)))$$

$$rj = (-0.99 * sin(0.1 * t + 1.4))$$

$$rk = 0 * t$$

$$r = [ri, rj, rk]$$

$$\frac{d}{dt}r$$

and normalizing the results of the derivative as Euclidean geometries. Since the left-right combination acts as a differential drive, angular velocity had to be calculated for each using Tangential and Normal Vectors derived, normalized, and crossed to produce an angular velocity to be used

$$T = \mathbf{v}(t)/v(t)$$

$$N = T'/|T'|$$

Using this angular velocity, we calculated the velocities for the left and right wheel, respectively after multiplying by the drive-train width of the NEATO.

$$V = \frac{V_L + V_R}{2}$$

$$\omega = \frac{V_R - V_L}{d}$$

$$V_L = V - \omega\frac{d}{2}$$

$$V_R = V + \omega\frac{d}{2}$$

Reconstructing the robot path from encoder data meant first converting Tangential and Normal vector components (T-hat and N-hat) into x and y functions that we could use to plot the 'actual path' taken by the robot, and compare it to the 'theoretically plotted path' using the calculated unit tangent and unit normal vectors based on the measured ri and rj.

Parametric Curve Plot

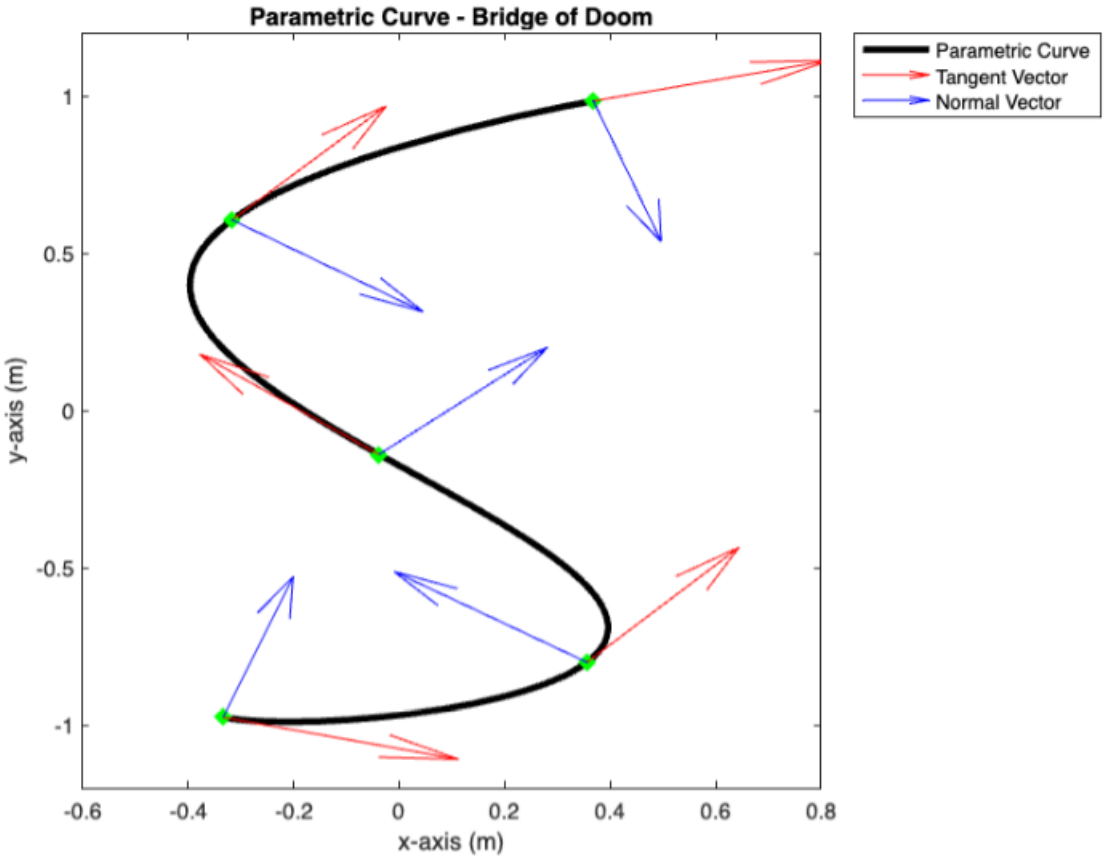

Figure 1: Parametric Curve with Tangent and Normal Vectors plotted at 4 distinct points

Linear Speed and Angular Velocity Plots

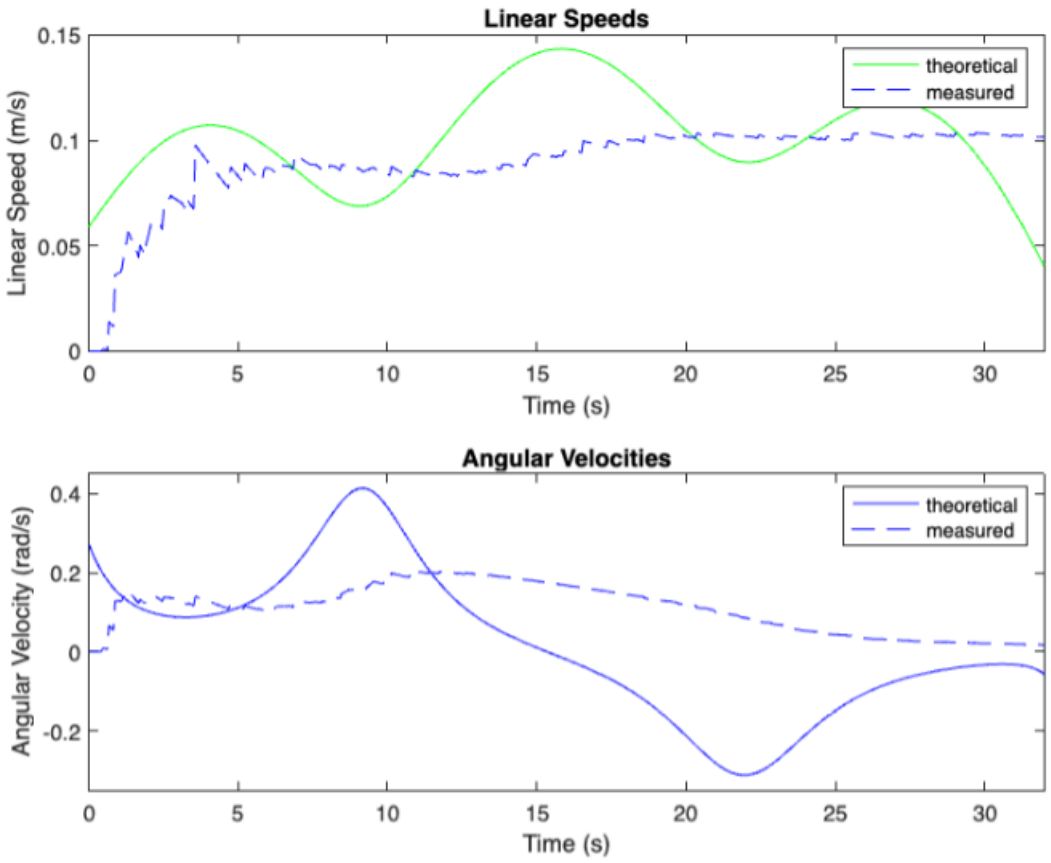

Figure 2: Linear Speed and Angular Velocity of the NEATO (theoretical vs measured)

Wheel Velocity Plot

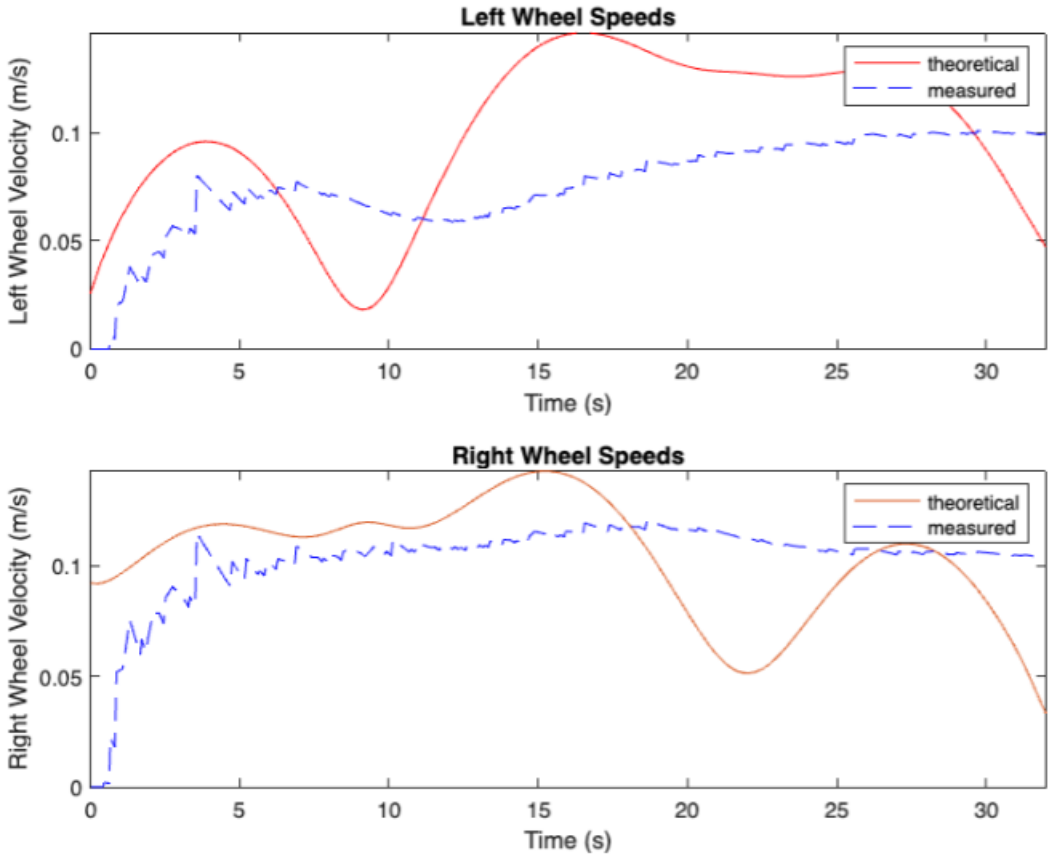

Figure 3: Left vs Right Wheel Velocities (theoretical vs measured)

Plot of Robot Path

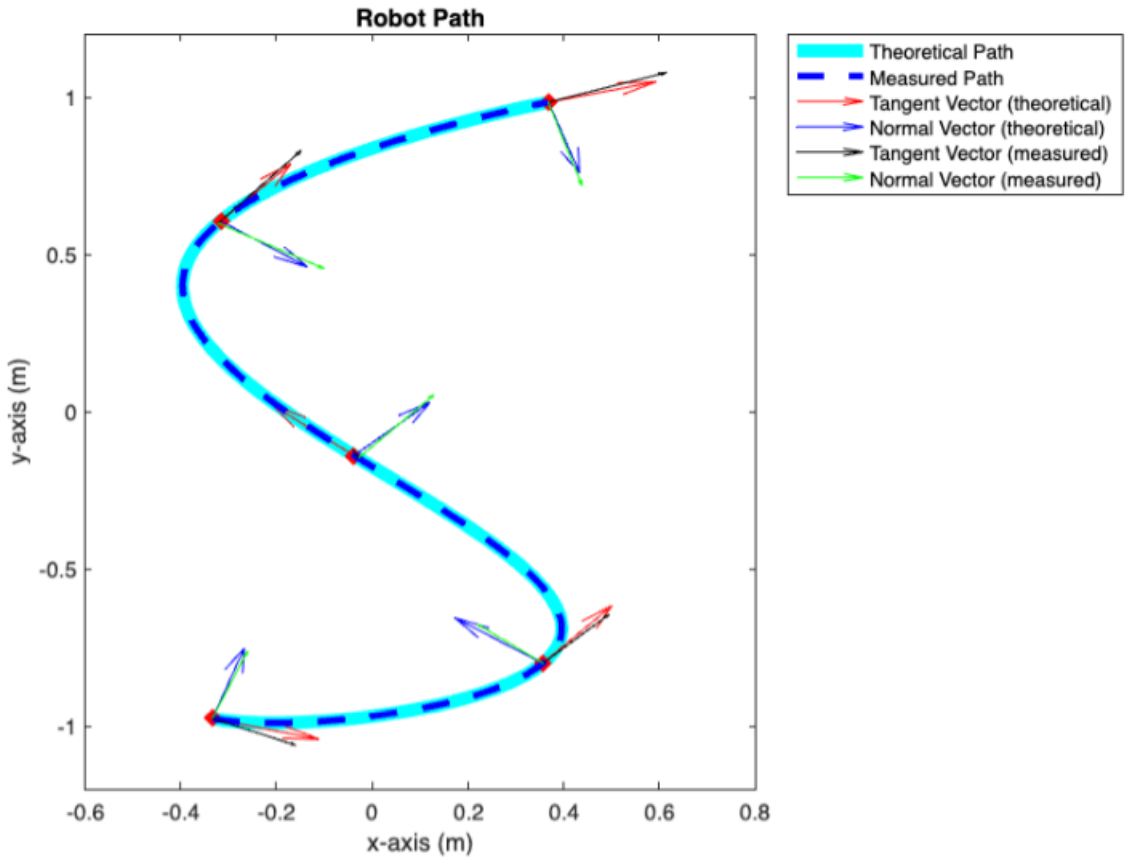

Figure 4: Overlaid Robot Path with Tangent and Normal Vectors (theoretical vs measured)

Video and Code

Click here to watch the robot in action as it traverses the Bridge of Doom

Click here to view the repository of magical code to overcome the Bridge of Doom: