Teleoperation & Robot Control

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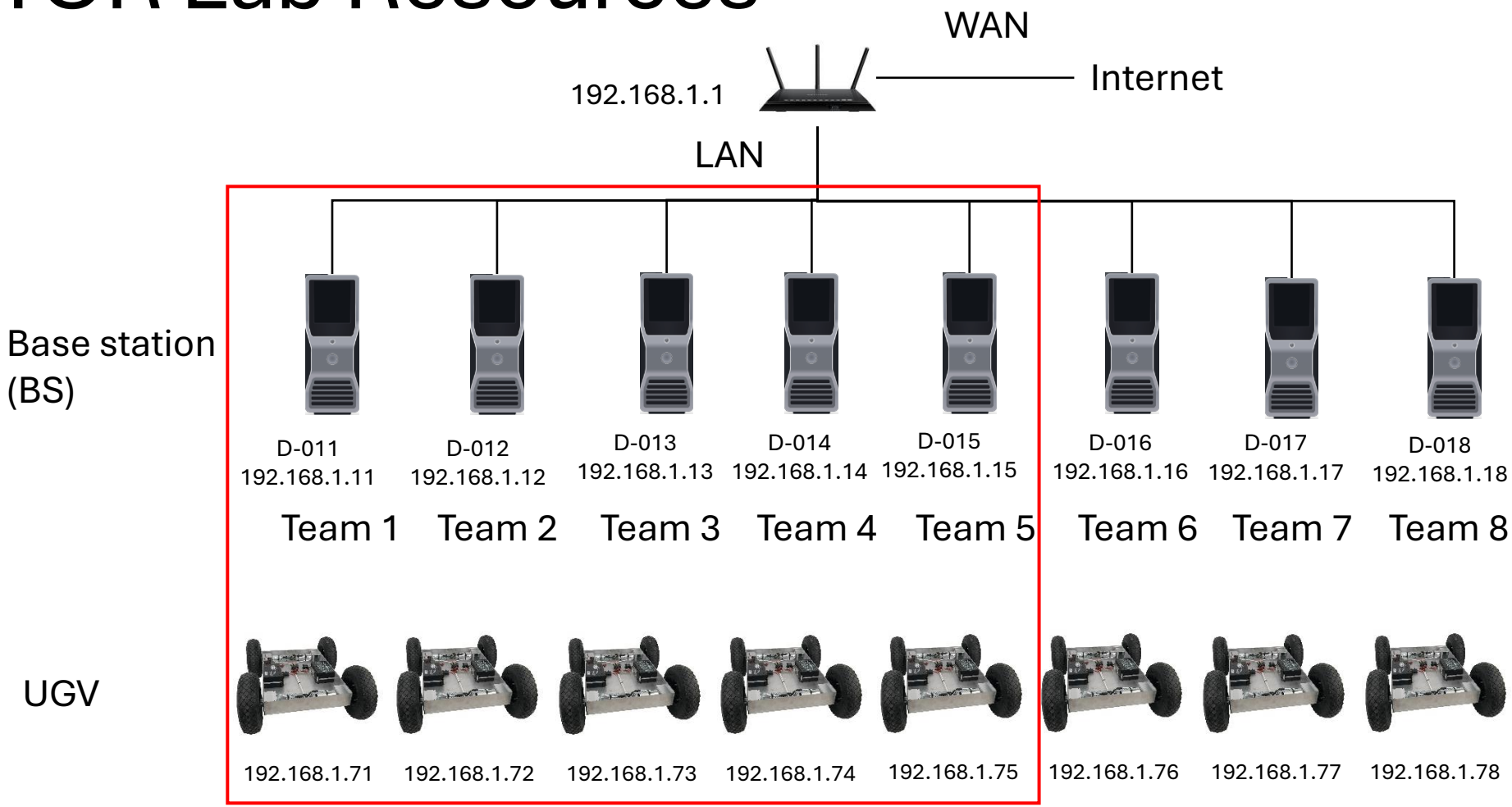
Wireless Communication

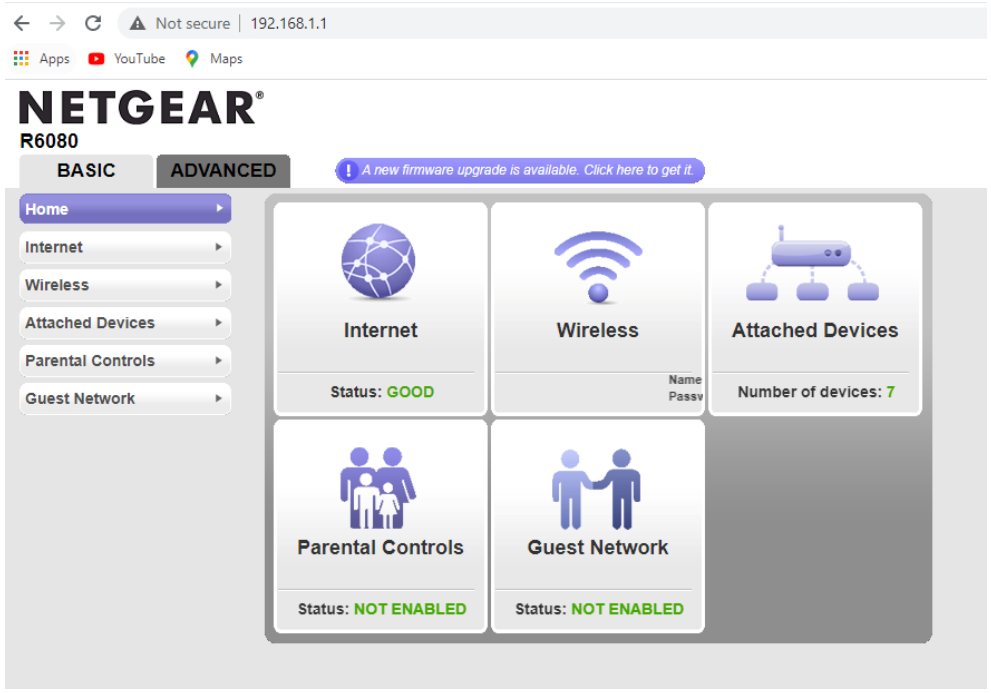
- 192.168.1.1: Wireless Router
- 192.168.1.5: Printer
- 192.168.1.11-70: Lab Computers (11-15 for machines numbered D-011, 012, 013, 014, 015)
- 192.168.1.71-100: Lab Robots
- 192.168.1.101-150: Other computers

VICTOR Lab Resources



Wireless Router

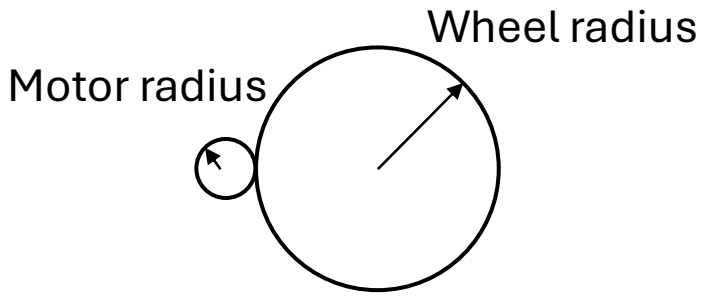
- SSID: *********
- Password: 0a0b0c0d0e0f0g0h
- http://192.168.1.1
- Login: admin
- Password: password



Gear Ratio

Gear ratio is taken into account as encoder readings will play a significant role when Simultaneous Localization and Mapping is handled later in the course.

$$\omega_w = \frac{R_m}{R_w}\omega_m$$



where R_m : Motor radius (Virtual)
R_w : Wheel radius
ω_m : Angular velocity of motor
ω_w : Angular velocity of wheel

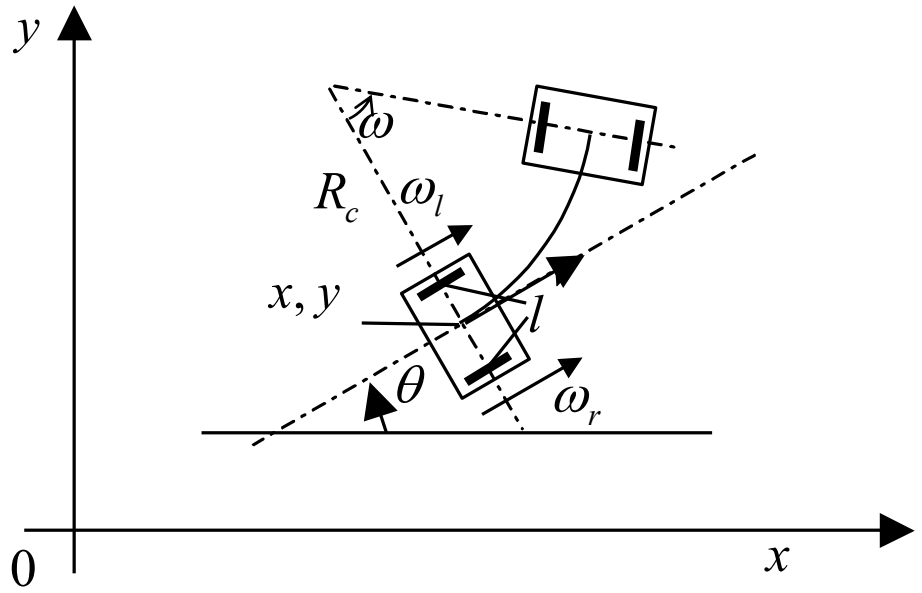
$$\eta = \frac{R_w}{R_m} >> 1$$

Differential Steering Platform
- Control Inputs -

Control inputs

Angular velocity of motor on left wheel: ω_l [rad/s]

Angular velocity of motor on right wheel: ω_r [rad/s]



Differential Steering Platform
- Linear and Angular Velocities -

Velocity of the center of robot

Linear velocity: $v = \frac{R_w \omega_m}{\eta}$

$$\longrightarrow \quad v = \frac{R_w}{\eta}\frac{\omega_l + \omega_r}{2} = \frac{R_w}{2\eta}\left(\omega_l + \omega_r\right)$$

Angular velocity: $l\omega = \frac{R_w}{\eta}\left(\omega_r - \omega_l\right)$

Linear difference in two angular velocities

$$\longrightarrow \quad \omega = \frac{R_w}{l\eta}\left(\omega_r - \omega_l\right)$$

Differential Steering Platform
- Motion Model -

Motion model:

$$\dot{\mathbf{x}} = \mathbf{f}\left(\mathbf{x}, \mathbf{u}\right)$$

$\mathbf{x}$: State

$\mathbf{u}$: Control

Position:

$$\begin{cases} \dot{x} = v\cos\theta = \dfrac{R_w}{2\eta}\left(\omega_l + \omega_r\right)\cos\theta \\ \dot{y} = v\sin\theta = \dfrac{R_w}{2\eta}\left(\omega_l + \omega_r\right)\sin\theta \end{cases}$$

Orientation:

$$\dot{\theta} = \frac{R_w}{l\eta}\left(\omega_r - \omega_l\right)$$

Simulation:

$$\mathbf{x}_k = \mathbf{x}_{k-1} + \Delta t\mathbf{f}\left(\mathbf{x}_{k-1}, \mathbf{u}_k\right)$$

k : Time step

Differential Steering Platform
- Left and Right Angular Velocities -

Left and right angular velocities:

$$\omega_r = \frac{\eta}{R_w}\left(\frac{l}{2}\omega + v\right)$$

$$\omega_l = \frac{\eta}{R_w}\left(-\frac{l}{2}\omega + v\right)$$

Exercise

1. Change the current slider bars of left and right wheels in the GUI to the slider bars of linear and angular velocities.
2. Enable linear motion by controlling the slider bar of linear velocity only.
3. Enable rotational motion by controlling the slider bar of angular velocity only.