DD ROBOT

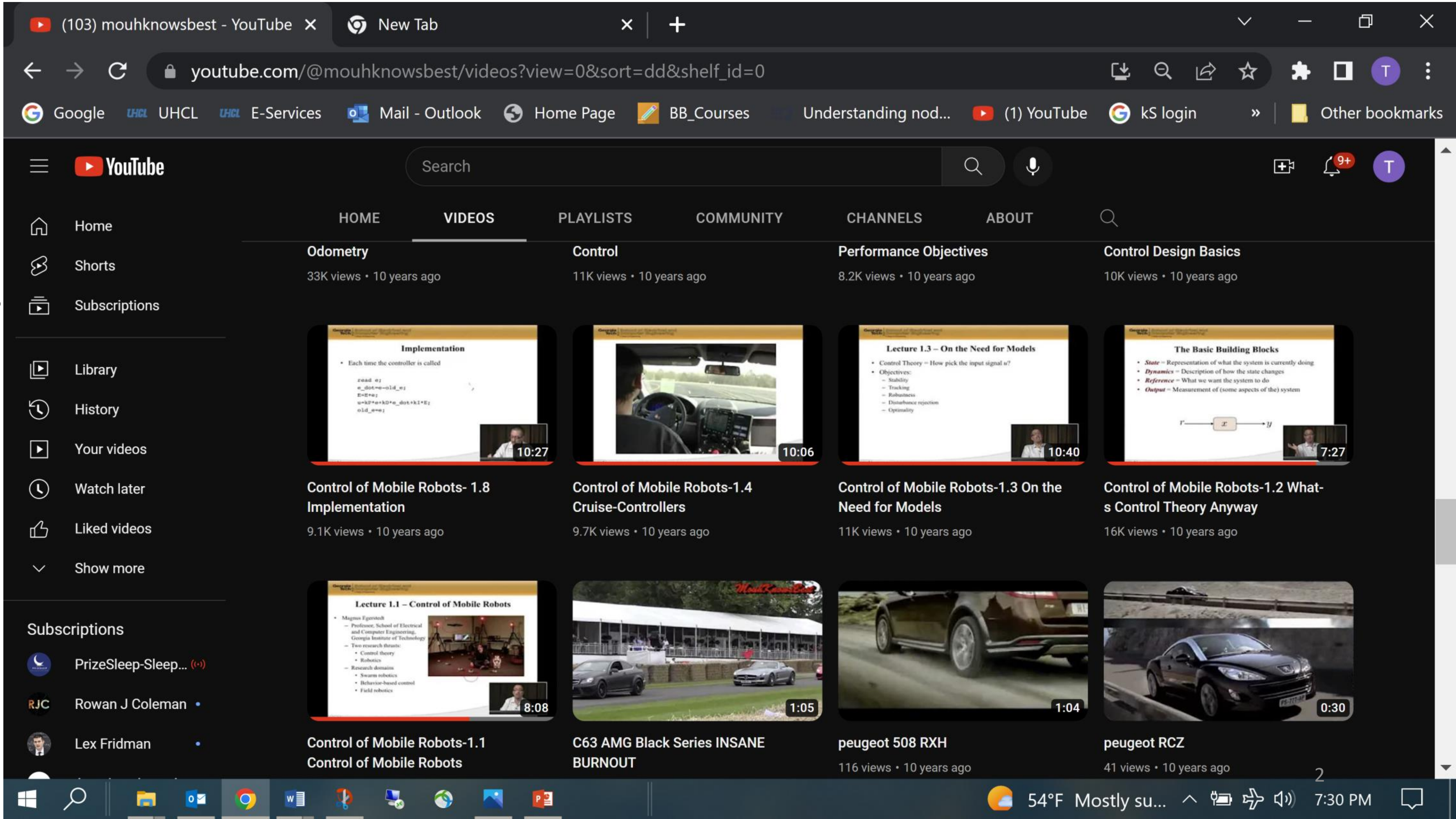
- Magnus Videos Control
- Differential Drive Robot (DD_Robot)
- Magnus Model of DD_Robot
- Engineering Education Academy Model

https://www.youtube.com/@mouhknowsbest

Magnus-

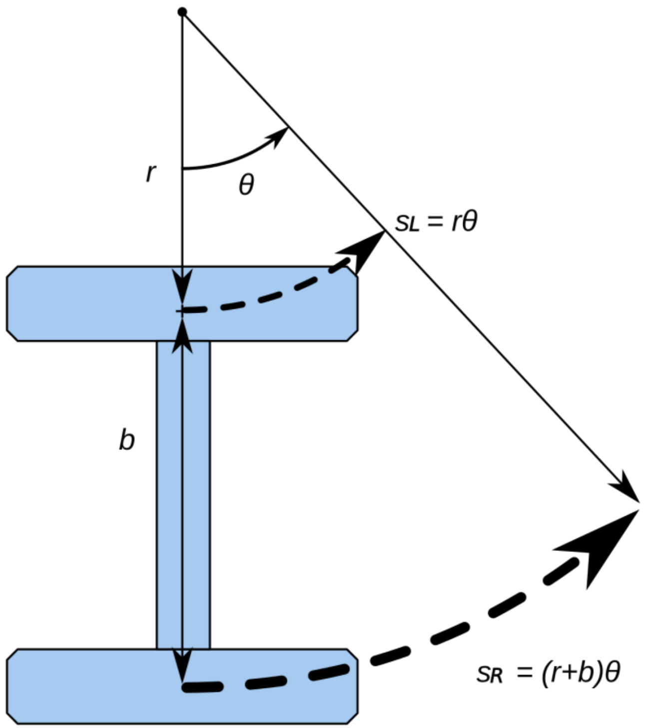
Control Videos

1.X Watch ALL



https://en.wikipedia.org/wiki/Differential_wheeled_robot

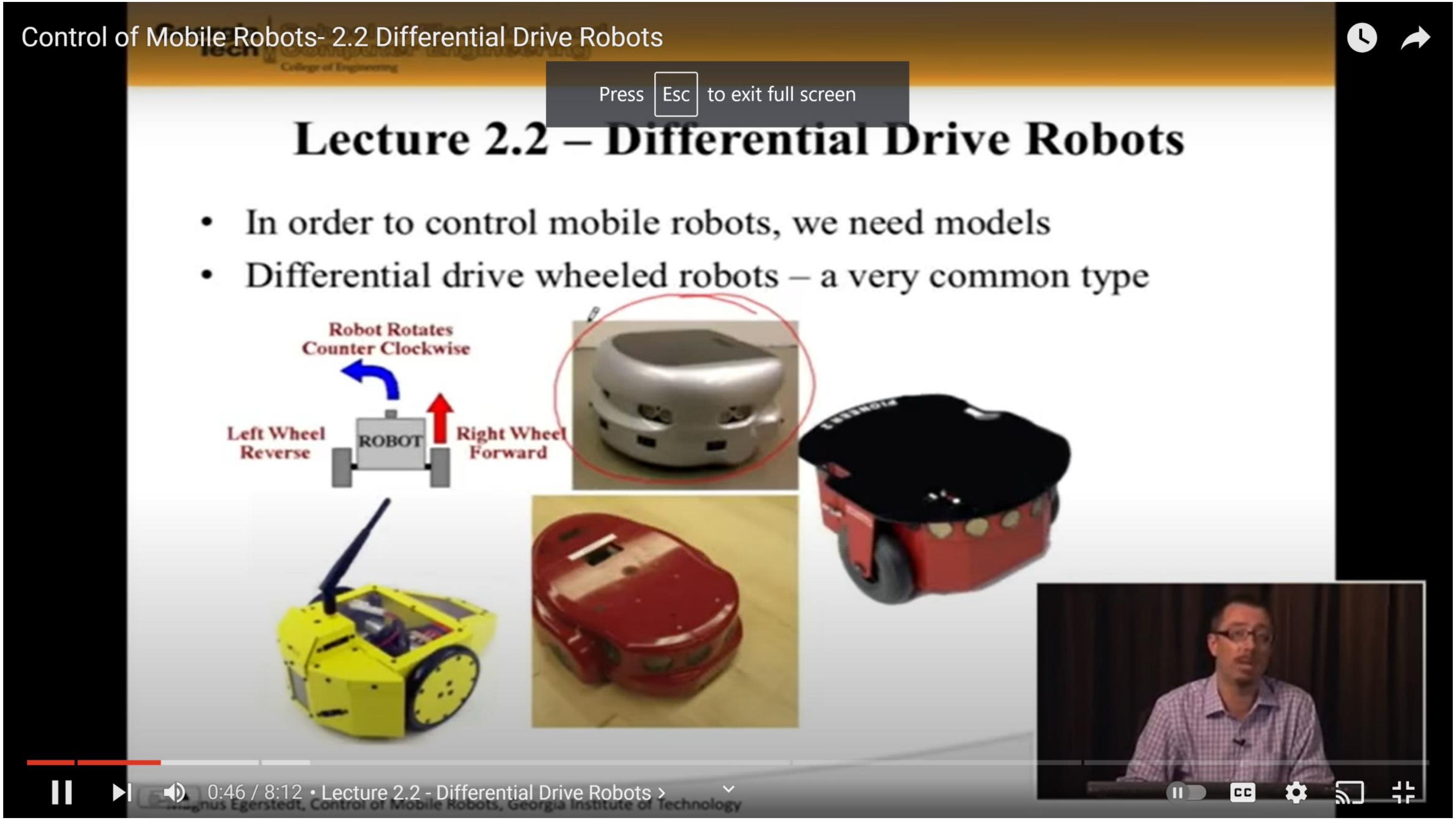
A **differential wheeled robot** is a mobile robot whose movement is based on two separately driven wheels placed on either side of the robot body. It can thus change its direction by varying the relative rate of rotation of its wheels and hence does not require an additional steering motion. Robots with such a drive typically have one or more castor wheels to prevent the vehicle from tilting.



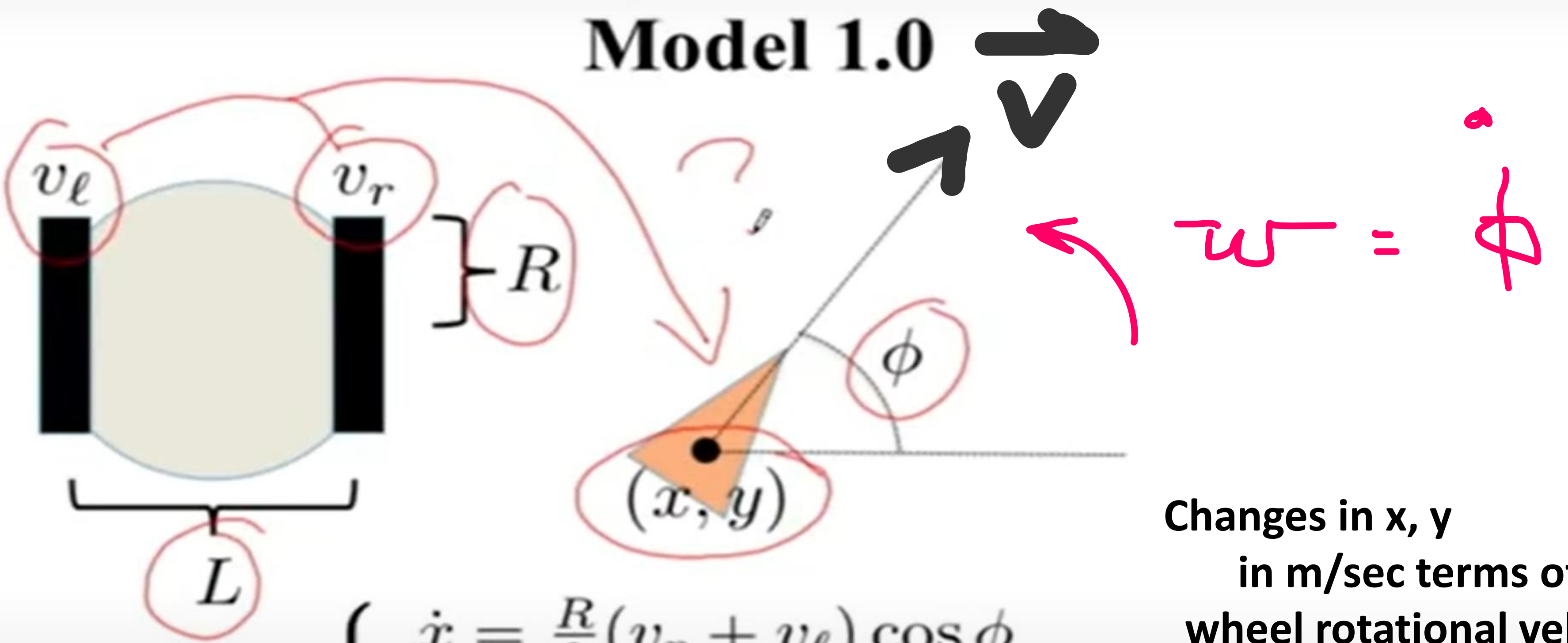
NOTE: NOATION DIFFERS
FOR EVERY DISCUSSION OF DD_ROBOTS!!

Magnus Bicycle Model mouhknowsbest Lecture 2.2 **Robots- 2.2 Differential Drive Robots 8:12**

https://www.youtube.com/watch?v=aE7RQNhwnPQ



Model 1.0



$$
\begin{cases}
\dot{x} = \frac{R}{2}(v_r + v_\ell)\cos\phi \\
\dot{y} = \frac{R}{2}(v_r + v_\ell)\sin\phi \\
\dot{\phi} = \frac{R}{L}(v_r - v_\ell)
\end{cases}
$$

Changes in x, y in m/sec terms of wheel rotational velocities rad/sec.

Magnus Result

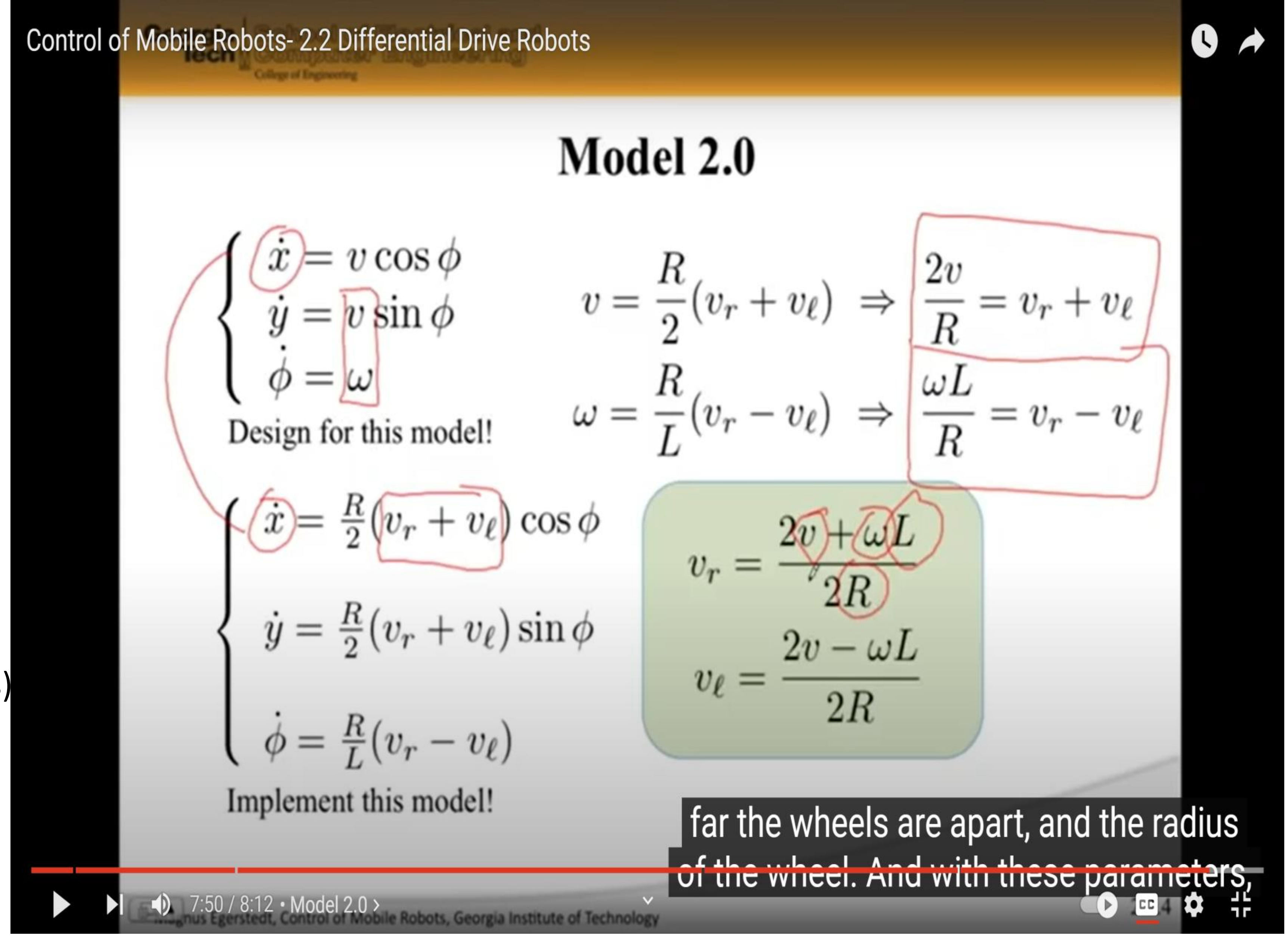
- R wheel radius (m)
- L wheel base (m)
- Vr, Vl wheel rotation (rad /sec)
- x projection of **V** on x axis
- y projection of **V** on y axis
- w robot rotation (rad/sec)

Inputs to Robot - Controlled

- Vr, Vl rate of rotation of wheels in radians/sec

Desired Motion of Robot (Commands)

- v m/s and w rad/sec
- So v is magnitude of vector **V**



Mouhknowsbest (Magnus) **Control of Mobile Robots- 2.2 Differential Drive Robots 8:12**

https://www.youtube.com/watch?v=aE7RQNhwnPQ

Engineering Education Academy

Kinematics of Differential Drive Robots and Odometry

https://www.youtube.com/watch?v=RZlZcDxQ8P4

12,491 views Jul 31, 2021 Robotics

Differential Forward Kinematics Equations of Differential-Drive robots along with explanation of the non-holonomic motion constraints for them and odometry accompanied by MATLAB demos and animations are studied in this video.

Robot Pose: 2:42
Derivation of Differential Forward Kinematics Equations: 3:24
Different Types of Motion for Differential-Drive Robots: 23:25
MATLAB Animation Demo: 28:07
Non-Holonomic* Motion Constraint: 31:17
Pfaffian Constraints: 37:41
Odometry: 38:54

* **Robot cannot move SIDEWAYS**

Kinematics of Differential Drive Robots and Odometry

Mobile Robot Kinematics

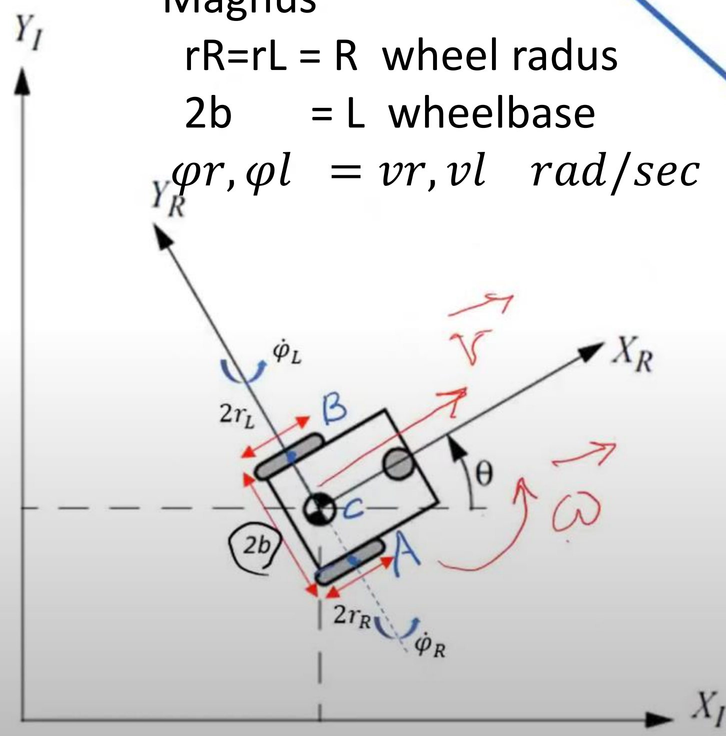
Difference in RPM of the wheels makes the robot move forward/backward and rotate:

Magnus

rR=rL = R wheel radus

2b = L wheelbase

$\varphi r, \varphi l = vr, vl \quad rad/sec$



$$\begin{bmatrix}\dot{x}\\ \dot{y}\\ \dot{\theta}\end{bmatrix} = R_z(\theta)\begin{bmatrix}V\\ 0\\ \omega\end{bmatrix} = \begin{bmatrix}\cos(\theta) & -\sin(\theta) & 0\\ \sin(\theta) & \cos(\theta) & 0\\ 0 & 0 & 1\end{bmatrix}\begin{bmatrix}V\\ 0\\ \omega\end{bmatrix} \quad (1)$$

$$\begin{bmatrix}V\\ \omega\end{bmatrix} = \begin{bmatrix}\frac{r_R}{2} & \frac{r_L}{2}\\ \frac{r_R}{2b} & -\frac{r_L}{2b}\end{bmatrix}\begin{bmatrix}\dot{\varphi}_R\\ \dot{\varphi}_L\end{bmatrix} \quad (2)$$

$$(1)\&(2) \Rightarrow \begin{bmatrix}\dot{x}\\ \dot{y}\\ \dot{\theta}\end{bmatrix} = \begin{bmatrix}\frac{r_R}{2}\cos(\theta) & \frac{r_L}{2}\cos(\theta)\\ \frac{r_R}{2}\sin(\theta) & \frac{r_L}{2}\sin(\theta)\\ \frac{r_R}{2b} & -\frac{r_L}{2b}\end{bmatrix}\begin{bmatrix}\dot{\varphi}_R\\ \dot{\varphi}_L\end{bmatrix} \quad (3)$$

GET USED TO VARIOUS NOTATIONS -

THE MATH RESULT SHOULD BE THE SAME