

Autonomous Car

$$1) \quad \mathcal{L}(f) = \int_0^{\infty} f(t) e^{-st} dt = F(s)$$

$$\mathcal{L}\left(\frac{d^2 f(t)}{dt^2}\right) = \int_0^{\infty} \frac{d^2}{dt^2} f(t) e^{-st} dt$$

$$= e^{-st} \frac{df(t)}{dt} \Big|_0^{\infty} + \int_0^{\infty} s e^{-st} \frac{df(t)}{dt} dt$$

$$= \lim_{t \rightarrow \infty} e^{-st} \frac{df(t)}{dt} - e^{-s(0)} \frac{df(0)}{dt} + s \left(sF(s) - f(0) \right)$$

$$= s^2 F(s) - s f(0) - \frac{df(0)}{dt}$$

$$= s^2 F(s) - s f(0) - f'(0)$$

2)

$$x'' + 3x' + 2x = 0$$

$$s^2 X(s) - s x(0) - x'(0) + 3s X(s) - 3x(0) + 2X(s) = 0$$

$$X(s)s^2 + 3sX(s) + 2X(s) - as - b - 3a = 0$$

$$X(s)s^2 + X(s)(3s+2) = as + b + 3a$$

$$X(s) \cdot (s^2 + 3s + 2) = as + b + 3a$$

$$X(s) = \frac{as + b + 3a}{(s+1)(s+2)}$$

$$= \frac{2a+b}{(s+1)(s+2)}$$

$$\frac{as + b + 3a}{(s+1)(s+2)} = \frac{A}{s+1} + \frac{B}{s+2}$$

$$as + b + 3a = As + 2A + Bs + B$$

$$= s(A+B) + 2A+B$$

$$A+B=a$$

$$B = -b - a$$

$$2A+B = b+3a$$

$$A+a = b+3a$$

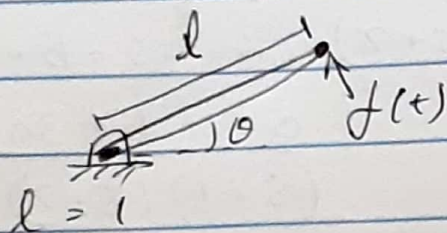
$$A = 2a+b$$

$$X(s) = \frac{2a+b}{s+1} - \frac{a+b}{s+2}$$

$$x(t) \rightarrow L^{-1}\left(\frac{1}{s+1}\right) = e^{-t} \quad L^{-1}\left(\frac{1}{s+2}\right) = e^{-2t}$$

$$x(t) = (2a+b)e^{-t} - (a+b)e^{-2t}$$

3)



Newton's second law

$$T = \cancel{f \times l} \quad j\omega$$

Torque generated

$$T = j^{(t)} \times l = f(t)$$

$$\omega = \theta''(t)$$

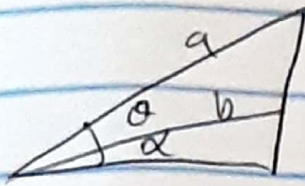
$$f(t) = J \theta''(t)$$

Taking Laplace transform

with zero initial condition

$$F(s) = J s^2 \theta(s)$$

$$\frac{X(s)}{R(s)} = \frac{\theta(s)}{F(s)} = \frac{1}{J s^2}$$



$$a \cos(\theta + \alpha) = b \cos(\alpha)$$

$$a \cos \theta \cos \alpha - a \sin \theta \sin \alpha = b \cos \alpha$$

÷ by $\cos \alpha$

$$a \cos \theta - a \sin \theta \tan \alpha = b$$

$$a \sin \theta \tan \alpha = a \cos \theta - b$$

$$\tan \alpha = \frac{a \cos \theta - b}{a \sin \theta}$$

$$\alpha = \tan^{-1} \left(\frac{a \cos \theta - b}{a \sin \theta} \right)$$

I am having trouble with simulator. It took me a while to figure out but my ~~mu~~-controller topic is not publishing to /drive and even when I press r or k nothing happens. Also my behaviour controller crashes everytime. Image attached.

process[random_walker-8]: started with pid [5114]
process[keyboard-9]: started with pid [5120]
process[rviz-10]: started with pid [5122]
process[pid_error_node-11]: started with pid [5130]
process[control_node-12]: started with pid [5138]
process[sim_connector_node-13]: started with pid [5140]
[INFO] [1587707019.258765503]: rviz version 1.13.7
[INFO] [1587707019.258839020]: compiled against Qt version 5.9.5
[INFO] [1587707019.265858416]: compiled against OGRE version 1.9.0 (Ghadamon)
[INFO] [1587707019.382671548]: Forcing OpenGL version 0.
[behavior_controller-7] Simulator constructed.
[behavior_controller-7] process has died [pid 5114, exit code -11, cmd /home/par
esh/Autonomous_racing/soni_f110_ws/devel/lib/racecar_simulator/behavior_controll
er __name:=behavior_controller __log:=/home/parash/.ros/log/8b31e02a-85ee-11ea-9
417-90fd61edc49c/behavior_controller-7.log].
log file: /home/parash/.ros/log/8b31e02a-85ee-11ea-9417-90fd61edc49c/behavior_co
ntroller-7*.log
[INFO] [1587707019.789734950]: Stereo is NOT SUPPORTED
[INFO] [1587707019.789837069]: OpenGL version: 3 (GLSL 1.3).
[INFO] [1587707020.278142260]: Creating 1 swatches
kn
[WARN] [1587707347.792667]: Inbound TCP/IP connection failed: connection from se
nder terminated before handshake header received. 0 bytes were received. Please

Interact Move Camera Select Focus Camera Measure 2D Pose Estimate 2D Nav Goal Publish Point

Display

paresh@paresh-MacBookPro: ~

File Edit View Search Terminal Tabs Help

/home/paresh/Autonomous_racing/soni_F... x paresh@paresh-MacBookPro: ~

```
paresh@paresh-MacBookPro:~$ rostopic echo /drive
WARNING: topic [/drive] does not appear to be published yet
```

Add Duplicate Remove

Time

ROS Time: 1587714314.66 ROS Elapsed: 10.90 Wall Time: 1587714314.69 Wall Elapsed: 10.83

Reset