Introduction to Robotics

CSCI/ATRI 4530/6530

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Announcements

Next class - Thursday 08/23/2018

- Next class - Monday (08/27) - Guest Lecture by Prof. Prashant Doshi (Sensors model - Rangefinders)
- **ROS Practicals for next week is Tuesday** (not Thursday if you follow the schedule) - so please bring your laptops on Tuesday (08/28)

A quick recap

Kinematics - basics

- Frames of references

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- ${}_I r_{RP} = \mathbf{R}_{\mathbf{RI}} \, {}_R r_{RP}$ - What is $\mathbf{R}_{\mathbf{RI}}$ here?
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- How about velocities?
- ${}_I \dot{\mathbf{r}}_{RP} = \mathbf{R}_{\mathbf{RI}} \, {}_R \dot{\mathbf{r}}_{RP}$
- Velocity of point P in a moving frame (R) : ${}_I \dot{\mathbf{r}}_{OP} = {}_I \dot{\mathbf{r}}_{OR} + \omega_{IR} r_{RP}$

Kinematics - basics - summary

- Translations $ {}_I\mathbf{r}_{OP_1} = {}_I\mathbf{r}_{OB} + {}_I\mathbf{r}_{BP_1} $
- Rotations $ {}_B\mathbf{r}_{OP_1} = \mathbf{R}_{BI}\, {}_I\mathbf{r}_{BP_1} $
- Homogeneous transformation $ \begin{pmatrix} {}_I\mathbf{r}_{OP_1} \\ 1 \end{pmatrix} = \begin{bmatrix} \mathbf{R}_{IB} & {}_I\mathbf{r}_{OB} \\ 0 & 1 \end{bmatrix} \begin{pmatrix} {}_B\mathbf{r}_{BP_1} \\ 1 \end{pmatrix} $
- Anglar velocities $ {}_I\boldsymbol{\omega}_{IC} = {}_I\boldsymbol{\omega}_{IB} + {}_I\boldsymbol{\omega}_{BC} $
- Differentiation of (position) vectors $ {}_B\mathbf{r} \Rightarrow {}_B(\dot{\mathbf{r}}) = \frac{d\,{}_B\mathbf{r}}{dt} + {}_B\boldsymbol{\omega}_{IB} \times {}_B\mathbf{r} $

Kinematics - wheeled robot platform - constraints

- Rolling constraint

$$\underbrace{[-\sin(\alpha+\beta) \quad \cos(\alpha+\beta) \quad l\cos\beta]}_{J_1(\beta_s)} R(\theta)\dot{\xi}_I - \dot{\varphi} r = 0$$

- No-sliding constraint

$$\underbrace{[\cos(\alpha+\beta) \quad \sin(\alpha+\beta) \quad l\sin\beta]}_{C_1(\beta_s)} R(\theta)\dot{\xi}_I = 0$$

$${}_W\mathbf{v}_{IW} = \begin{bmatrix} 0 \\ \dot{\varphi} r \\ 0 \end{bmatrix} \begin{array}{l} \text{- no-sliding constraint} \\ \text{- rolling constraint} \\ \text{- planar assumption} \end{array}$$

For today

Today's topics

- Kinematics - Degree of Manuerability - Attached slides from EdX
- Probability basics - Additional slides

For next class

Next class - Monday 08/27/2018

- Sensors model - Laser range scanners - Prof. Doshi