DTU

Unmanned Autonomous Systems - 31390

List of Symbols – Week1

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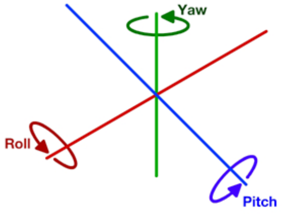
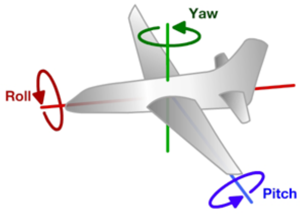
Euler angles

Roll-Pitch-Yaw Euler angles (X-Y-Z)





ϕ roll angle: rotation around the local x-axis

θ pitch angle: rotation around the local y-axis

ψ yaw angle: rotation around the local z-axis

$\vec{\alpha} = [\phi, \theta, \psi]^\top$ vector of Euler angles (here called alpha, but it could take any symbol)

$R(\vec{\alpha})$ Rotation matrix describing the rotation of a frame, with respect to another, according to the chosen angular notation described by vector

Modeling of a Quadrotor: Kinematic variables

$\vec{x} = (x, y, z)^\top$ vector describing the position of the body-fixed frame w.r.t. the inertia frame

$\dot{\vec{x}} = (\dot{x}, \dot{y}, \dot{z})^\top$ vector describing the velocity of the body-fixed frame w.r.t. the inertia frame

$\vec{\theta} = (\phi, \theta, \psi)^\top$ vector describing the angular position, according to our particular choice of Euler angles, of the body-fixed frame w.r.t. the inertia frame

$\dot{\vec{\theta}} = (\dot{\phi}, \dot{\theta}, \dot{\psi})^\top$ derivative of $\vec{\theta}$

$\vec{\omega}$ vector describing the angular velocity of the body-fixed frame

$\dot{\vec{\omega}}$ angular acceleration, derivative over $\vec{\omega}$ time of

Modeling of a Quadrotor

L	Distance between the propeller's axis of rotation and the z-axis of the body-fixed frame
k	Parameter describing the relation between the aerodynamic lift of the propellers and the propellers' angular velocity^2
b	Parameter describing the relation between the aerodynamic drag of the propellers and the propellers' angular velocity^2
$\Omega_1 \cdots \Omega_4$	Propellers' angular velocity
f_i	vertical force (on the axis of rotation) of the i-th propeller
τ_i	torque around the axis of rotation of the i-th propeller
k_d	Parameter describing the viscosity of a mean (e.g. air) in which a body moves
g	gravity (9.81m/s^2)
R	Rotation matrix of body-fixed frame w.r.t. inertia frame

Modeling of a Quadrotor

$$\mathbf{m} = \begin{bmatrix} m & 0 & 0 \\ 0 & m & 0 \\ 0 & 0 & m \end{bmatrix}$$

matrix of mass

$$I = \begin{bmatrix} I_{xx} & 0 & 0 \\ 0 & I_{yy} & 0 \\ 0 & 0 & I_{zz} \end{bmatrix}$$

inertia matrix of the drone (in this case diagonal, but generally full)

$\vec{F_B}$ Vector describing the net force generated by the propellers on the body-fixed frame

$\vec{\tau_B}$ Vector describing the net torque generated by the propellers on the body-fixed frame

$\vec{F_D}$ Vector describing the viscous force generated by the body moving in a viscous mean (e.g. air)

$$F_D = \begin{bmatrix} -k_d\dot{x} \\ -k_d\dot{y} \\ -k_d\dot{z} \end{bmatrix}$$