TUM Institute for Cognitive Systems (ICS)

OpenWalker

Module Description: Command Generator (CMDGENM)

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1 Module Description

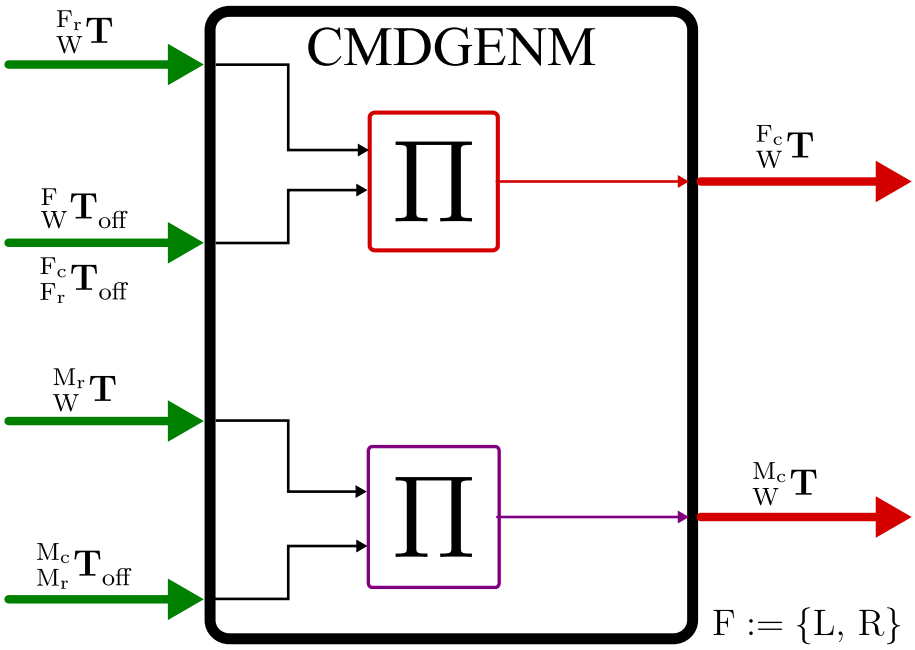

Figure 1.1: Command Generator: This module computes the commanded Cartesian pose for both feet and the center of mass.

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The *Command Generator* module (CmdGen) computes the commanded Cartesian pose for both feet and the center of mass. A command is constructed from a planned reference pose that should be tracked by the robot and an offset that corrects for external disturbances such as e.g. unknown ground conditions. The offset stores relative translational and rotational corrections that are applied to the reference trajectory to ensure tracking.
Finally, the commanded Cartesian poses are send to the *Inverse Kinematics* solver (IK).

2 Module Connections

2.1 Inputs

Symbol	Name	Type	Description
${}^{L_r}_{W}\mathbf{T} \in \mathbb{R}^{4\times4}$	Left Foot Reference Coordinate Frame	`HomogeneousTransformation`	This homogeneous transformation matrix contains the reference pose of the left foot ankle coordinate frame L with respect to the world coordinate frame W.
${}^{R_r}_{W}\mathbf{T} \in \mathbb{R}^{4\times4}$	Right Foot Reference Coordinate Frame	`HomogeneousTransformation`	This homogeneous transformation matrix contains the reference pose of the right foot ankle coordinate frame R with respect to the world coordinate frame W.
${}^{M_r}_{W}\mathbf{T} \in \mathbb{R}^{4\times4}$	Center of Mass Reference Coordinate Frame	`HomogeneousTransformation`	This homogeneous transformation matrix contains the reference pose of the Center of Mass coordinate frame M with respect to the world coordinate frame W.
${}^{L_c}_{L_r}\mathbf{T}_{off} \in \mathbb{R}^{4\times4}$	Left Foot Offset Transformation	`HomogeneousTransformation`	This homogeneous transformation matrix contains the relative offset for the left foot reference Coordinate Frame L.
${}^{R_c}_{R_r}\mathbf{T}_{off} \in \mathbb{R}^{4\times4}$	Right Foot Offset Transformation	`HomogeneousTransformation`	This homogeneous transformation matrix contains the relative offset for the right foot reference Coordinate Frame R.
${}^{M_c}_{M_r}\mathbf{T}_{off} \in \mathbb{R}^{4\times4}$	Right Foot Offset Transformation	`HomogeneousTransformation`	This homogeneous transformation matrix contains the relative offset for the center of mass reference Coordinate Frame M.

2.2 Outputs

Symbol	Name	Type	Description
${}^{L_c}_{W}\mathbf{T} \in \mathbb{R}^{4\times4}$	Left Foot Commanded Transformation	`HomogeneousTransformation`	This homogeneous transformation matrix contains the commanded pose of the left foot ankle coordinate frame L with respect to the world coordinate frame W.
${}^{R_c}_{W}\mathbf{T} \in \mathbb{R}^{4\times4}$	Right Foot Commanded Transformation	`HomogeneousTransformation`	This homogeneous transformation matrix contains the commanded pose of the right foot ankle coordinate frame R with respect to the world coordinate frame W.
${}^{M_c}_{W}\mathbf{T} \in \mathbb{R}^{4\times4}$	Center of Mass Commanded Transformation	`HomogeneousTransformation`	This homogeneous transformation matrix contains the commanded pose of the center of mass coordinate frame M with respect to the world coordinate frame W.

2.3 Inter-Connections

The CmdGen is connected to the output of the *Foot Trajectory Generator* (FTG) which provides a reference pose for both feet. The translational and rotational offsets applied to this reference are received through a connection to the *Foot Compliant Model* (FCM).
The *Center of Mass Trajectory Generator* (CoMTG) provides a reference pose for the center of mass. The CoM offsets are generated by the *Balancer* module.

The commanded output poses for feet and CoM are send to the *Inverse Kinematics* solver (IK) to compute the required joint space coordinates.

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2.4 Common Methods

Both, the reference poses and offsets are represented by Affine Transformation matrices. The pose commands are then obtained by multiplying the references with their corresponding offsets.

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