

kinetics

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# Chapter 1

## Class Index

### 1.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

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## Chapter 2

# Class Documentation

## 2.1 Kinematics Class Reference

### Public Member Functions

- **Kinematics** (bool state=true)
- Eigen::MatrixXd **ForwardKin** (const Eigen::MatrixXd &M, const Eigen::MatrixXd &Slist, const Eigen::VectorXd &thetaList)  
*Compute end effector frame.*
- bool **InverseKin** (const Eigen::MatrixXd &Slist, const Eigen::MatrixXd &M, const Eigen::MatrixXd &T, Eigen::VectorXd &thetalist, double eomg, double ev)  
*Compute joints thetas given the end-effector configuration.*
- Eigen::MatrixXd **Jacobian** (const Eigen::MatrixXd &Slist, const Eigen::MatrixXd &thetaList)  
*Gives the Jacobian.*

### Public Attributes

- bool **space\_state**

### 2.1.1 Member Function Documentation

#### 2.1.1.1 ForwardKin()

```
Eigen::MatrixXd Kinematics::ForwardKin (  
    const Eigen::MatrixXd & M,  
    const Eigen::MatrixXd & Slist,  
    const Eigen::VectorXd & thetaList )
```

Compute end effector frame.

## Parameters

<i>M,Home</i>	configuration of end-effector
<i>Slist</i>	joint screw axis in (space_state by default, unless space_state is false for body state), when the manipulator is at home position.
<i>thetaList</i>	A list of joint coordinates.

## Returns

T transformation matrix representing the end-effector frame when the joints are at the specified coordinates

**2.1.1.2 InverseKin()**

```
bool Kinematics::InverseKin (
    const Eigen::MatrixXd & Slist,
    const Eigen::MatrixXd & M,
    const Eigen::MatrixXd & T,
    Eigen::VectorXd & thetalist,
    double eomg,
    double ev )
```

Compute joints thetas given the end-effector configuration.

## Parameters

<i>Slist</i>	screw axis (space_state by default, unless space_state is false for body state),
<i>M</i>	is home configuration of end-effector
<i>T</i>	is the target configuration
<i>thetalist</i>	the the desired joint angles to calculate
<i>eomg, ev</i>	are error checkers

## Returns

boolean success flag

**2.1.1.3 Jacobian()**

```
Eigen::MatrixXd Kinematics::Jacobian (
    const Eigen::MatrixXd & Slist,
    const Eigen::MatrixXd & thetaList )
```

Gives the Jacobian.



## Parameters

<i>Slist</i>	Screw axis
<i>thetaList</i>	joint configuration

## Returns

6xn Spatial Jacobian

The documentation for this class was generated from the following files:

- /home/poetry/recovery/MR/kinetics/include/kinematics.hpp
- /home/poetry/recovery/MR/kinetics/src/kinematics.cpp

## 2.2 Kinetics Class Reference

### Public Member Functions

- Eigen::VectorXd [InverseDynamics](#) (const Eigen::VectorXd &thetalist, const Eigen::VectorXd &dthetalist, const Eigen::VectorXd &ddthetalist, const Eigen::VectorXd &g, const Eigen::VectorXd &Ftip, const std::vector< Eigen::MatrixXd > &Mlist, const std::vector< Eigen::MatrixXd > &Glist, const Eigen::MatrixXd &Slist) const  
*Uses forward-backward Newton-Euler iterations to solve the equation:  $\tau_{\text{ulist}} = \text{Mlist}(\text{thetalist}) * \text{ddthetalist} + \text{c}(\text{thetalist}, \text{dthetalist}) + \text{g}(\text{thetalist}) + \text{Jtr}(\text{thetalist}) * \text{Ftip}$ .*
- Eigen::VectorXd [ForwardDynamics](#) (const Eigen::VectorXd &thetalist, const Eigen::VectorXd &dthetalist, const Eigen::VectorXd &taulist, const Eigen::VectorXd &g, const Eigen::VectorXd &Ftip, const std::vector< Eigen::MatrixXd > &Mlist, const std::vector< Eigen::MatrixXd > &Glist, const Eigen::MatrixXd &Slist) const  
*Computes ddthetalist by solving:  $\text{Mlist}(\text{thetalist}) * \text{ddthetalist} = \tau_{\text{ulist}} - \text{c}(\text{thetalist}, \text{dthetalist})$*
- void **EulerStep** (Eigen::VectorXd &thetalist, Eigen::VectorXd &dthetalist, const Eigen::VectorXd &ddthetalist, double dt) const
- Eigen::VectorXd **ComputedTorque** (const Eigen::VectorXd &thetalist, const Eigen::VectorXd &dthetalist, const Eigen::VectorXd &eint, const Eigen::VectorXd &g, const std::vector< Eigen::MatrixXd > &Mlist, const std::vector< Eigen::MatrixXd > &Glist, const Eigen::MatrixXd &Slist, const Eigen::VectorXd &thetalistd, const Eigen::VectorXd &dthetalistd, const Eigen::VectorXd &ddthetalistd, double Kp, double Ki, double Kd)
- std::vector< Eigen::MatrixXd > **SimulateControl** (const Eigen::VectorXd &thetalist, const Eigen::VectorXd &dthetalist, const Eigen::VectorXd &g, const Eigen::MatrixXd &Ftipmat, const std::vector< Eigen::MatrixXd > &Mlist, const std::vector< Eigen::MatrixXd > &Glist, const Eigen::MatrixXd &Slist, const Eigen::MatrixXd &thetamatd, const Eigen::MatrixXd &dthetamatd, const Eigen::MatrixXd &ddthetamatd, const Eigen::VectorXd &gtilde, const std::vector< Eigen::MatrixXd > &Mtildelist, const std::vector< Eigen::MatrixXd > &Gtildelist, double Kp, double Ki, double Kd, double dt, int intRes)

### 2.2.1 Member Function Documentation

### 2.2.1.1 ForwardDynamics()

```
Eigen::VectorXd Kinetics::ForwardDynamics (
    const Eigen::VectorXd & thetalist,
    const Eigen::VectorXd & dthetalist,
    const Eigen::VectorXd & taulist,
    const Eigen::VectorXd & g,
    const Eigen::VectorXd & Ftip,
    const std::vector< Eigen::MatrixXd > & Mlist,
    const std::vector< Eigen::MatrixXd > & Glist,
    const Eigen::MatrixXd & Slist ) const [inline]
```

Computes ddthetalist by solving:  $Mlist(thetalist) * ddthetalist = taulist - c(thetalist, dthetalist)$

- $g(thetalist) - Jtr(thetalist) * Ftip$

#### Parameters

<i>thetalist</i>	n-vector of joint variables
<i>dthetalist</i>	n-vector of joint rates
<i>taulist</i>	An n-vector of joint forces/torques
<i>g</i>	Gravity vector g
<i>Ftip</i>	Spatial force applied by the end-effector expressed in frame {n+1}
<i>Mlist</i>	List of link frames {i} relative to {i-1} at the home position
<i>Glist</i>	Spatial inertia matrices $G_i$ of the links
<i>Slist</i>	Screw axes $S_i$ of the joints in a space frame, in the format of a matrix with the screw axes as the columns.

#### Returns

ddthetalist The resulting joint accelerations.

### 2.2.1.2 InverseDynamics()

```
Eigen::VectorXd Kinetics::InverseDynamics (
    const Eigen::VectorXd & thetalist,
    const Eigen::VectorXd & dthetalist,
    const Eigen::VectorXd & ddthetalist,
    const Eigen::VectorXd & g,
    const Eigen::VectorXd & Ftip,
    const std::vector< Eigen::MatrixXd > & Mlist,
    const std::vector< Eigen::MatrixXd > & Glist,
    const Eigen::MatrixXd & Slist ) const [inline]
```

Uses forward-backward Newton-Euler iterations to solve the equation:  $taulist = Mlist(thetalist) * ddthetalist + c(thetalist, dthetalist) + g(thetalist) + Jtr(thetalist) * Ftip$ .

## Parameters

<i>thetalist</i>	n-vector of joint variables
<i>dthetalist</i>	n-vector of joint rates
<i>ddthetalist</i>	n-vector of joint accelerations
<i>g</i>	Gravity vector $g$
<i>Ftip</i>	Spatial force applied by the end-effector expressed in frame $\{n+1\}$
<i>Mlist</i>	List of link frames $\{i\}$ relative to $\{i-1\}$ at the home position
<i>Glist</i>	Spatial inertia matrices $G_i$ of the links
<i>Slist</i>	Screw axes $S_i$ of the joints in a space frame, in the format of a matrix with the screw axes as the columns.

## Returns

taulist The n-vector of required joint forces/torques

The documentation for this class was generated from the following files:

- /home/poetry/recovery/MR/kinetics/include/kinetics.hpp
- /home/poetry/recovery/MR/kinetics/src/kinetics.cpp

## 2.3 Trajectory Class Reference

Collaboration diagram for Trajectory:



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