gomotion

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Module Documentation

5.1 The Go Motion Pose Mathematics Library

Go Math Representations

Positions are vectors that indicate where something is. In the three-dimensional world, three numbers are necessary to indicate position. Go Motion supports position vectors in several representations: Cartesian, cylindrical and spherical.

The Cartesian representation uses three numbers **x**, **y** and **z** to represent distances from the origin along three perpendicular axes. The cylindrical representation uses three numbers **r**, **theta** and **z** to represent radial distance away from the origin, angle around the origin and distance up and down from the origin respectively. The spherical representation uses three numbers **theta**, **phi** and **r** to represent angle down from the zenith, angle around the origin and radius from the origin respectively. Go Motion has functions that convert position in one representation position in another representation, so the choice of which representation to use can be made for convenience. Cartesian representations will be assumed unless otherwise specified.

Orientations are vectors that indicate how something is rotated. In the three-dimensional world, three numbers are necessary to indicate orientation. Go Motion supports orientation vectors in several representations: roll, pitch and yaw; Euler angles; quaternions; rotation vectors and rotation matrices. Some of these representations use more than three numbers, exploiting redundancy to make calculations with these representations more efficient. For example, a quaternion uses four numbers, and a rotation matrix uses nine numbers.

Vectors are usually written as a column of numbers enclosed in vertical bars, like this:

| 1 |

| 2 | - a vector depicted in its column form

| 3 |

This can be unwieldy in text documentation, so vectors may also be written as a row of numbers enclosed in parentheses, like this:

(1 2 3) - a vector depicted in its row form

The interpretation of a vector depends on the quantity it represents. The vector shown above could mean a translation of 1, 2 and 3 units in the x, y and z directions if the vector were a Cartesian position, or a rotation of 1, 2 and 3 units around the x, y and z directions if the vector were an orientation in roll, pitch and yaw.

Both position and orientation are needed to fully describe where something is and how it is rotated. The combination of position and orientation is called a 'pose'. Poses can be shown in row form like this pose representing a Cartesian position of (1 2 3) and an orientation in roll, pitch and yaw of (30 -30 90):

(1 2 3 ; 30 -30 90)

A semicolon is used to separate the position from the orientation.

Go Math Reference Frames

Regardless of the representation chosen, the numbers that indicate position and orientation of an object depend on the established origin. Several origins may be established for convenience, for example one fixed on the world and one that moves with a tool. These origins may differ from each other in both position and orientation. The establishment of the position and orientation of an origin is a 'reference frame'. The term 'coordinate frame' is used interchangeably with 'reference frame'.

When several reference frames are being used, they are denoted as identifiers in braces, for example,

{A} - a reference frame called 'A'.

{world} - the world reference frame.

{tool} - the world reference frame.

To convert the representation of a pose in one reference frame to its representation in another, one needs to know the position and orientation of one origin with respect to the other. This difference between the two origins is called a 'transform'.

Poses and transforms are similar things; both include position and orientation. Whether something is a pose or a transform depends on how one is using it. Poses are used to indicate the position and orientation of things with respect to an established reference frame. Transforms are used to indicate the position and orientation of reference frames with respect to other reference frames. If a 'thing' happens to be a reference frame, its pose is its transform.

Go Math Nomenclature

The letter **P** is used to denote positions and the letter **R** is used to denote orientations. As usual, trailing subscripts denote the identity of quantities, for example,

P_{hand} - the position of the hand.

R_{head} - the orientation of the head.

Leading superscripts denote the reference frame in which the quantity is expressed, for example,

${}^{A}P_{hand}$ - the position of the hand with respect to the {A} reference frame.

${}^{B}R_{head}$ - the orientation of the head with respect to the {B} reference frame.

The figure below shows a rotation of reference frame {B} with respect to reference frame {A} by an angle **u**. Note that the rotation can be viewed as a rotation of {B} with respect to {A}, denoted ${}^{A}u_{B}$, or as a rotation of {A} with respect to {B}, denoted ${}^{B}u_{A}$. The heads of arrows are attached to the 'of the' frames, while the tails of arrows are based on the 'with respect to' frames. Angles are taken as positive according the the right hand rule, so in this figure ${}^{A}u_{B}$ is a positive number of about 45 degrees, while ${}^{B}u_{A}$ is a negative number of the same magnitude.

Figure 1.

Transforms from one reference frame to another are denoted with leading subscripts and superscripts. The leading subscript denotes the original frame, and the leading superscript denotes the new frame. If a transform is purely rotation, it is denoted with an **R**, for example,

${}^{B}_{A}R$ - a rotation from the {A} frame to the {B} frame.

If a transform includes both a rotation and a translation, it is denoted with a **T**, for example,

${}^{world}_{tool}T$ - a transform from the {tool} frame to the {world} frame.

To convert a quantity from one frame to another, pre-multiply the quantity by the transform. Algebraically, the leading subscript of the transform must match the leading superscript of the quantity, for example,

${}^{B}P = {}^{B}_{A}R * {}^{A}P$

This is read, 'the position with respect to the B frame is the rotation from the A frame to the B frame times the position with respect to the A frame.' Another example is,

$^{world}P = {}^{world}_{tool}T * {}^{tool}P$

This is read, 'the position with respect to the world frame is the transform from the tool frame to the world frame times the position with respect to the tool frame.'

One can generate a rotational transform by defining an orientation vector with the appropriate angles. If using a roll, pitch and yaw representation, the rotational transforms in the figure above (each about the **z** axis) is a yaw:

$|\ 0\ |$

$|\ 0\ | = {}^{A}R_{B}$

$|\ {}^{A}u_{B}\ |$

$|\ 0\ |$

$|\ 0\ | = {}^{B}R_{A}$

$|\ {}^{B}u_{A}\ |$

and negative angles work as well, for

$|\ 0\ |$

$|\ 0\ | = {}^{A}R_{B}$

$|\ -{}^{B}u_{A}\ |$

Go Math Examples

Given a reference frame {B} rotated 30 degrees with respect to the **z** axis of reference frame {A}, as in Figure 1 above, transform from points in the {B} frame to points in the {A} frame like this:

```
go_rpy rot;
go_cart pt_in_b;
go_cart pt_in_a;

// The angle of {B} with respect to {A} is 30 degrees.
// Go uses angles in radians.
rot.r = 0, rot.p = 0, rot.y = GO_TO_RAD(30);

pt_in_b.x = 1, pt_in_b.y = 2, pt_in_b.z = 3;

// Multiply a transform and a point to get a new point.
go_rpy_cart_mult(&rot, &pt_in_b, &pt_in_a);

go_cart_print(&pt_in_a);
```

will print the postion of the point in the {A} frame:

```
-0.133975 2.232051 3.000000
```

Here is a more complex example of a full transform, including both translation and rotation.

Figure 2.

The frame {B} is translated and rotated with respect to {A}. ${}^{A}x_{B}$ is the amount of translation of {B} in the **x** direction of {A}. Likewise, ${}^{A}y_{B}$ is the amount of translation of {B} in the **y** direction of {A}. ${}^{A}u_{B}$ is the rotation of the {B} frame about the **z** axis of the {A} frame.

To convert points in the {B} frame to points in the {A} frame, do this:

```
go_pose pose;
go_rpy rot;
go_cart pt_in_b;
go_cart pt_in_a;

// The translation of {B} with respect to {A} is about (2 1 0).
pose.tran.x = 2, pose.tran.y = 1, pose.tran.z = 0;

// The angle of {B} wrt {A} is about 30 degrees, made into radians.
rot.r = 0, rot.p = 0, rot.y = GO_TO_RAD(30);

// A 'go_pose' uses quaternions for rotations, so we have to
// convert a roll-pitch-yaw to a quaternion.
go_rpy_quat_convert(&rot, &pose.rot);

pt_in_b.x = 1, pt_in_b.y = 2, pt_in_b.z = 3;

// Multiply a transform and a point to get a new point.
go_pose_cart_mult(&pose, &pt_in_b, &pt_in_a);

go_cart_print(&pt_in_a);
```

This gives the transformed point in the {A} frame as

```
1.866025 3.232051 3.000000
```

5.2 Trajectory Planning Algorithms

gotraj.c

gotraj.c Trajectory planning functions

CV means constant velocity, CA means constant acceleration, CJ means constant jerk. !

The Go Motion trajectory planning algorithms are based on smooth velocity profiling with bounded speed, acceleration and jerk, called "constant jerk" or "S-curve" velocity profiling. This gives smoother control than "trapezoidal" velocity profiling, which transitions instantaneously between acceleration and no acceleration and incurs spikes in unbounded jerk.

Constant-jerk (CJ) profiling is shown in Figure 1, a plot of the speed versus time. There are 7 phases to the motion. Phase 1 is a jerk phase, where the acceleration varies smoothly from 0 at time 0 to *a1* at time *t1* following the jerk (change in acceleration per unit time) *j0*. Phase 2 is an acceleration phase, with constant acceleration *a1* throughout. Phase 3 is a jerk phase (or de-jerk phase) with constant (negative) jerk slowing down the acceleration from *a1* to 0. Phase 4 is a constant speed phase at speed *v3*. Phase 5 is a constant-jerk counterpart to phase 3, where the deceleration varies smoothly from 0 to *-a1*. Phase 6 is a constant-acceleration counterpart to phase 2. Phase 7 is a constant-jerk counterpart to phase 1, where the deceleration varies smoothly from *-a1* to 0 and motion stops. Figure 1. Constant jerk velocity profiling.

Chapter 6

Namespace Documentation

6.1 gomotion Namespace Reference

Data Structures

- struct go_motion_interface
- struct points

    This structure holds the points to be interpolated.
- struct coeff

    This structure holds the polynomial coefficients.
- class go_interp

    The interpolator structure.
- struct go_cart
- struct go_sph
- struct go_cyl
- struct go_rvec
- struct go_mat
- struct go_quat
- struct go_zyz
- struct go_zyx
- struct go_xyz
- struct go_rpy
- struct go_uxz
- struct go_pose
- struct go_vel
- struct go_hom
- struct go_line
- struct go_plane
- struct go_matrix
- struct go_dh
- struct go_pk
- struct go_pp
- struct go_body
- struct go_link
- struct go_complex

- struct go_quadratic
- struct go_cubic
- struct go_quartic
- struct go_position

  Depending upon whether you are doing joint interpolation or world coordinate interpolation (as specified by your call to go_motion_queue_set_type()), fill in joint[] or pose accordingly.
- struct go_motion_params
- struct go_motion_linear_params

  In the following comments, LIN, CIR and ALL refer to linear moves, circular moves and both, respectively.
- struct go_motion_circular_params
- struct go_motion_spec
- struct go_scale_spec
- struct go_motion_queue
- struct GoMotionParams
- class GoMotion
- struct go_traj_ca_spec
- struct go_traj_cj_spec
- struct go_traj_interp_spec

Typedefs

- typedef go_real go_vector
- typedef
  sensor_msgs::JointState_
  < std::allocator< void > > JointState

Enumerations

- enum { COEFF_MAX = 6 }

  How many coefficients we support, one more than max polynomial degree.
- enum { GO_LINK_DH = 1, GO_LINK_PK, GO_LINK_PP }
- enum {
  GO_MOTION_NONE, GO_MOTION_JOINT, GO_MOTION_UJOINT, GO_MOTION_WORLD,
  GO_MOTION_LINEAR, GO_MOTION_CIRCULAR }

Functions

- void sincos (double x, double ∗sx, double ∗cx)
- void go_sincos (go_real t, go_real ∗s, go_real ∗c)
- go_result go_asines (go_real s, go_real ∗asp, go_real ∗asn)
- go_result go_acoses (go_real c, go_real ∗acp, go_real ∗acn)
- go_result go_atans (go_real t, go_real ∗atp, go_real ∗atn)
- go_real go_cbrt (go_real x)
- go_result go_cart_sph_convert (const go_cart ∗v, go_sph ∗s)
- go_result go_cart_cyl_convert (const go_cart ∗v, go_cyl ∗c)
- go_result go_sph_cart_convert (const go_sph ∗s, go_cart ∗v)
- go_result go_sph_cyl_convert (const go_sph ∗s, go_cyl ∗c)
- go_result go_cyl_cart_convert (const go_cyl ∗c, go_cart ∗v)
- go_result go_cyl_sph_convert (const go_cyl ∗c, go_sph ∗s)

- go_result go_rvec_quat_convert (const go_rvec ∗r, go_quat ∗q)
- go_result go_rvec_mat_convert (const go_rvec ∗r, go_mat ∗m)
- go_result go_rvec_zyz_convert (const go_rvec ∗rvec, go_zyz ∗zyz)
- go_result go_rvec_zyx_convert (const go_rvec ∗rvec, go_zyx ∗zyx)
- go_result go_rvec_rpy_convert (const go_rvec ∗r, go_rpy ∗rpy)
- go_result go_quat_rvec_convert (const go_quat ∗q, go_rvec ∗r)
- go_result go_quat_mat_convert (const go_quat ∗q, go_mat ∗m)
- go_result go_quat_zyz_convert (const go_quat ∗q, go_zyz ∗zyz)
- go_result go_quat_zyx_convert (const go_quat ∗q, go_zyx ∗zyx)
- go_result go_quat_rpy_convert (const go_quat ∗q, go_rpy ∗rpy)
- go_result go_mat_rvec_convert (const go_mat ∗m, go_rvec ∗r)
- go_result go_mat_quat_convert (const go_mat ∗m, go_quat ∗q)
- go_result go_mat_zyz_convert (const go_mat ∗m, go_zyz ∗zyz)
- go_result go_mat_zyx_convert (const go_mat ∗m, go_zyx ∗zyx)
- go_result go_mat_xyz_convert (const go_mat ∗m, go_xyz ∗xyz)
- go_result go_mat_rpy_convert (const go_mat ∗m, go_rpy ∗rpy)
- go_result go_zyz_rvec_convert (const go_zyz ∗zyz, go_rvec ∗r)
- go_result go_zyz_quat_convert (const go_zyz ∗zyz, go_quat ∗q)
- go_result go_zyz_mat_convert (const go_zyz ∗zyz, go_mat ∗m)
- go_result go_zyz_zyx_convert (const go_zyz ∗zyz, go_zyx ∗zyx)
- go_result go_zyz_rpy_convert (const go_zyz ∗zyz, go_rpy ∗rpy)
- go_result go_zyx_rvec_convert (const go_zyx ∗zyx, go_rvec ∗r)
- go_result go_zyx_quat_convert (const go_zyx ∗zyx, go_quat ∗q)
- go_result go_zyx_mat_convert (const go_zyx ∗zyx, go_mat ∗m)
- go_result go_zyx_zyz_convert (const go_zyx ∗zyx, go_zyz ∗zyz)
- go_result go_zyx_rpy_convert (const go_zyx ∗zyx, go_rpy ∗rpy)
- go_result go_xyz_mat_convert (const go_xyz ∗xyz, go_mat ∗m)
- go_result go_rpy_rvec_convert (const go_rpy ∗rpy, go_rvec ∗rvec)
- go_result go_rpy_quat_convert (const go_rpy ∗rpy, go_quat ∗quat)
- go_result go_rpy_mat_convert (const go_rpy ∗rpy, go_mat ∗m)
- go_result go_rpy_zyz_convert (const go_rpy ∗rpy, go_zyz ∗zyz)
- go_result go_rpy_zyx_convert (const go_rpy ∗rpy, go_zyx ∗zyx)
- go_result go_uxz_mat_convert (const go_uxz ∗uxz, go_mat ∗mat)
- go_result go_mat_uxz_convert (const go_mat ∗mat, go_uxz ∗uxz)
- go_pose go_pose_this (go_real x, go_real y, go_real z, go_real rs, go_real rx, go_real ry, go_real rz)
- go_cart go_cart_zero (void)
- go_quat go_quat_identity (void)
- go_pose go_pose_identity (void)
- go_result go_pose_hom_convert (const go_pose ∗p, go_hom ∗h)
- go_result go_hom_pose_convert (const go_hom ∗h, go_pose ∗p)
- go_result go_cart_rvec_convert (const go_cart ∗cart, go_rvec ∗rvec)
- go_result go_rvec_cart_convert (const go_rvec ∗rvec, go_cart ∗cart)
- go_flag go_cart_cart_compare (const go_cart ∗v1, const go_cart ∗v2)
- go_result go_cart_cart_dot (const go_cart ∗v1, const go_cart ∗v2, go_real ∗d)
- go_result go_cart_cart_cross (const go_cart ∗v1, const go_cart ∗v2, go_cart ∗vout)
- go_result go_cart_mag (const go_cart ∗v, go_real ∗d)
- go_result go_cart_magsq (const go_cart ∗v, go_real ∗d)
- go_flag go_cart_cart_par (const go_cart ∗v1, const go_cart ∗v2)
- go_flag go_cart_cart_perp (const go_cart ∗v1, const go_cart ∗v2)
- go_result go_cart_cart_disp (const go_cart ∗v1, const go_cart ∗v2, go_real ∗d)
- go_result go_cart_cart_add (const go_cart ∗v1, const go_cart ∗v2, go_cart ∗vout)

- go_result go_cart_cart_sub (const go_cart ∗v1, const go_cart ∗v2, go_cart ∗vout)
- go_result go_cart_scale_mult (const go_cart ∗v1, go_real d, go_cart ∗vout)
- go_result go_cart_neg (const go_cart ∗v1, go_cart ∗vout)
- go_result go_cart_unit (const go_cart ∗v, go_cart ∗vout)
- go_result go_cart_is_norm (const go_cart ∗v)
- go_result go_cart_cart_rot (const go_cart ∗v1, const go_cart ∗v2, go_quat ∗quat)
- go_result go_cart_cart_proj (const go_cart ∗v1, const go_cart ∗v2, go_cart ∗vout)
- go_result go_cart_plane_proj (const go_cart ∗v, const go_cart ∗normal, go_cart ∗vout)
- go_result go_cart_cart_angle (const go_cart ∗v1, const go_cart ∗v2, go_real ∗a)
- go_result go_cart_normal (const go_cart ∗v, go_cart ∗vout)
- go_result go_cart_centroid (const go_cart ∗varray, go_integer num, go_cart ∗centroid)
- go_result go_cart_centroidize (const go_cart ∗vinarray, go_integer num, go_cart ∗centroid, go_cart ∗voutarray)
- go_complex go_complex_add (go_complex z1, go_complex z2)
- go_complex go_complex_sub (go_complex z1, go_complex z2)
- go_complex go_complex_mult (go_complex z1, go_complex z2)
- go_complex go_complex_inv (go_complex z, go_result ∗result)
- go_complex go_complex_div (go_complex z1, go_complex z2, go_result ∗result)
- go_complex go_complex_sq (go_complex z)
- go_complex go_complex_scale (go_complex z, go_real scale)
- go_real go_complex_mag (go_complex z)
- go_real go_complex_magsq (go_complex z)
- go_real go_complex_arg (go_complex z)
- void go_complex_sqrt (go_complex z, go_complex ∗z1, go_complex ∗z2)
- void go_complex_cbrt (go_complex z, go_complex ∗z1, go_complex ∗z2, go_complex ∗z3)
- go_result go_quadratic_solve (const go_quadratic ∗quad, go_complex ∗z1, go_complex ∗z2)
- go_result go_cubic_solve (const go_cubic ∗cub, go_complex ∗z1, go_complex ∗z2, go_complex ∗z3)
- go_result go_quartic_solve (const go_quartic ∗quart, go_complex ∗z1, go_complex ∗z2, go_complex ∗z3, go_-complex ∗z4)
- go_result go_tridiag_reduce (go_real ∗∗a, go_integer n, go_real ∗d, go_real ∗e)
- go_result go_tridiag_ql (go_real ∗d, go_real ∗e, go_integer n, go_real ∗∗z)
- go_result go_cart_cart_pose (const go_cart ∗v1, const go_cart ∗v2, go_cart ∗v1c, go_cart ∗v2c, go_integer num, go_pose ∗pout)
- go_result go_cart_trilaterate (const go_cart ∗c1, const go_cart ∗c2, const go_cart ∗c3, go_real l1, go_real l2, go_real l3, go_cart ∗out1, go_cart ∗out2)
- go_flag go_rvec_rvec_compare (const go_rvec ∗r1, const go_rvec ∗r2)
- go_result go_rvec_scale_mult (const go_rvec ∗r, go_real s, go_rvec ∗rout)
- go_result go_rpy_cart_mult (const go_rpy ∗rpy, const go_cart ∗in, go_cart ∗out)
- go_result go_mat_norm (const go_mat ∗mat, go_mat ∗mout)
- go_flag go_mat_is_norm (const go_mat ∗m)
- go_result go_mat_inv (const go_mat ∗m, go_mat ∗mout)
- go_result go_mat_cart_mult (const go_mat ∗m, const go_cart ∗v, go_cart ∗vout)
- go_result go_mat_mat_mult (const go_mat ∗m1, const go_mat ∗m2, go_mat ∗mout)
- go_flag go_quat_quat_compare (const go_quat ∗q1, const go_quat ∗q2)
- go_result go_quat_mag (const go_quat ∗quat, go_real ∗d)
- go_result go_quat_unit (const go_quat ∗q1, go_quat ∗qout)
- go_result go_quat_norm (const go_quat ∗q1, go_quat ∗qout)
- go_result go_quat_inv (const go_quat ∗q1, go_quat ∗qout)
- go_flag go_quat_is_norm (const go_quat ∗q1)
- go_result go_quat_scale_mult (const go_quat ∗q, go_real s, go_quat ∗qout)
- go_result go_quat_quat_mult (const go_quat ∗q1, const go_quat ∗q2, go_quat ∗qout)
- go_result go_quat_cart_mult (const go_quat ∗q1, const go_cart ∗v2, go_cart ∗vout)

- go_flag go_pose_pose_compare (const go_pose ∗p1, const go_pose ∗p2)
- go_result go_pose_inv (const go_pose ∗p1, go_pose ∗p2)
- go_result go_pose_cart_mult (const go_pose ∗p1, const go_cart ∗v2, go_cart ∗vout)
- go_result go_pose_pose_mult (const go_pose ∗p1, const go_pose ∗p2, go_pose ∗pout)
- go_result go_pose_scale_mult (const go_pose ∗p1, go_real s, go_pose ∗pout)
- go_result go_pose_pose_interp (go_real t1, const go_pose ∗p1, go_real t2, const go_pose ∗p2, go_real t3, go_-pose ∗p3)
- go_result go_hom_inv (const go_hom ∗h1, go_hom ∗h2)
- go_result go_hom_hom_mult (const go_hom ∗h1, const go_hom ∗h2, go_hom ∗hout)
- go_result go_pose_vel_mult (const go_pose ∗pose, const go_vel ∗vel, go_vel ∗out)
- go_result go_line_from_point_direction (const go_cart ∗point, const go_cart ∗direction, go_line ∗line)
- go_result go_line_from_points (const go_cart ∗point1, const go_cart ∗point2, go_line ∗line)
- go_result go_line_from_planes (const go_plane ∗plane1, const go_plane ∗plane2, go_line ∗line)
- go_flag go_line_line_compare (const go_line ∗line1, const go_line ∗line2)
- go_result go_line_evaluate (const go_line ∗line, go_real d, go_cart ∗point)
- go_result go_point_line_distance (const go_cart ∗point, const go_line ∗line, go_real ∗distance)
- go_result go_point_line_proj (const go_cart ∗point, const go_line ∗line, go_cart ∗pout)
- go_result go_point_plane_proj (const go_cart ∗point, const go_plane ∗plane, go_cart ∗proj)
- go_result go_line_plane_proj (const go_line ∗line, const go_plane ∗plane, go_line ∗proj)
- go_result go_plane_from_point_normal (const go_cart ∗point, const go_cart ∗normal, go_plane ∗plane)
- go_result go_plane_from_abcd (go_real A, go_real B, go_real C, go_real D, go_plane ∗plane)
- go_result go_plane_from_points (const go_cart ∗point1, const go_cart ∗point2, const go_cart ∗point3, go_plane ∗plane)
- go_result go_plane_from_point_line (const go_cart ∗point, const go_line ∗line, go_plane ∗plane)
- go_flag go_plane_plane_compare (const go_plane ∗plane1, const go_plane ∗plane2)
- go_result go_point_plane_distance (const go_cart ∗point, const go_plane ∗plane, go_real ∗distance)
- go_result go_plane_evaluate (const go_plane ∗plane, go_real u, go_real v, go_cart ∗point)
- go_result go_line_plane_intersect (const go_line ∗line, const go_plane ∗plane, go_cart ∗point, go_real ∗distance)
- go_real go_get_singular_epsilon (void)
- go_result go_set_singular_epsilon (go_real epsilon)
- go_result ludcmp (go_real ∗∗a, go_real ∗scratchrow, go_integer n, go_integer ∗indx, go_real ∗d)
- go_result lubksb (go_real ∗∗a, go_integer n, go_integer ∗indx, go_real ∗b)
- go_result go_cart_vector_convert (const go_cart ∗c, go_real ∗v)
- go_result go_vector_cart_convert (const go_real ∗v, go_cart ∗c)
- go_result go_quat_matrix_convert (const go_quat ∗quat, go_matrix ∗matrix)
- go_result go_mat_matrix_convert (const go_mat ∗mat, go_matrix ∗matrix)
- go_result go_matrix_matrix_add (const go_matrix ∗a, const go_matrix ∗b, go_matrix ∗apb)
- go_result go_matrix_matrix_copy (const go_matrix ∗src, go_matrix ∗dst)
- go_result go_matrix_matrix_mult (const go_matrix ∗a, const go_matrix ∗b, go_matrix ∗ab)
- go_result go_matrix_vector_mult (const go_matrix ∗a, const go_vector ∗v, go_vector ∗axv)
- go_result go_matrix_vector_cross (const go_matrix ∗a, const go_vector ∗v, go_matrix ∗axv)
- go_result go_matrix_transpose (const go_matrix ∗a, go_matrix ∗at)
- go_result go_matrix_inv (const go_matrix ∗m, go_matrix ∗minv)
- go_result go_mat3_inv (go_real a[3][3], go_real ainv[3][3])
- go_result go_mat3_mat3_mult (go_real a[3][3], go_real b[3][3], go_real axb[3][3])
- go_result go_mat3_vec3_mult (go_real a[3][3], go_real v[3], go_real axv[3])
- go_result go_mat4_inv (go_real a[4][4], go_real ainv[4][4])
- go_result go_mat4_mat4_mult (go_real a[4][4], go_real b[4][4], go_real axb[4][4])
- go_result go_mat4_vec4_mult (go_real a[4][4], go_real v[4], go_real axv[4])
- go_result go_mat6_inv (go_real a[6][6], go_real ainv[6][6])
- go_result go_mat6_transpose (go_real a[6][6], go_real at[6][6])

- go_result go_mat6_mat6_mult (go_real a[6][6], go_real b[6][6], go_real axb[6][6])
- go_result go_mat6_vec6_mult (go_real a[6][6], go_real v[6], go_real axv[6])
- go_result go_dh_hom_convert (const go_dh ∗dh, go_hom ∗h)
- go_result go_dh_pose_convert (const go_dh ∗dh, go_pose ∗p)
- go_result go_hom_dh_convert (const go_hom ∗h, go_dh ∗dh)
- go_result go_pose_dh_convert (const go_pose ∗p, go_dh ∗dh)
- go_result go_link_joint_set (const go_link ∗link, go_real joint, go_link ∗linkout)
- go_result go_link_pose_build (const go_link ∗link_params, go_integer num, go_pose ∗pose)
- go_result go_linear_cos_sin_solve (go_real a, go_real b, go_real ∗th1, go_real ∗th2)
- go_result go_rvec_xyz_convert (const go_rvec ∗, go_xyz ∗)
- go_result go_quat_xyz_convert (const go_quat ∗, go_xyz ∗)
- go_result go_zyz_xyz_convert (const go_zyz ∗, go_xyz ∗)
- go_result go_zyx_xyz_convert (const go_zyx ∗, go_xyz ∗)
- go_result go_xyz_rvec_convert (const go_xyz ∗, go_rvec ∗)
- go_result go_xyz_quat_convert (const go_xyz ∗, go_quat ∗)
- go_result go_xyz_zyz_convert (const go_xyz ∗, go_zyz ∗)
- go_result go_xyz_zyx_convert (const go_xyz ∗, go_zyx ∗)
- go_result go_xyz_rpy_convert (const go_xyz ∗, go_rpy ∗)
- go_result go_rpy_xyz_convert (const go_rpy ∗, go_xyz ∗)
- go_result go_traj_ca_generate (go_real acc, go_real deltacc, go_real deltvel, go_traj_ca_spec ∗pts)

  go_traj_ca_generate() takes an accel value, and intervals for the accel period and cruise period, and fills in the go_traj_-ca_spec with the interval parameters.
- go_result go_traj_ca_compute (go_real d, go_real v, go_real a, go_traj_ca_spec ∗pts)

  go_traj_ca_compute() takes values for distance 'd' to move, max velocity 'v' to limit if necessary, and constant accel 'a', and fills in the go_traj_ca_spec with the interval parameters.
- go_result go_traj_ca_scale (const go_traj_ca_spec ∗ts, go_real t, go_traj_ca_spec ∗pts)

  go_traj_ca_scale() takes a time 't' for the desired time of the motion, and scales the times and motion params so that the total distance remains the same and everything else is in proportion
- go_result go_traj_ca_stop (const go_traj_ca_spec ∗ts, go_real t, go_traj_ca_spec ∗pts)

  go_traj_ca_stop() takes a time 't' for the desired time to begin stopping, and recomputes the times so that the move will stop as soon as possible during subsequent interps.
- go_result go_traj_ca_extend (const go_traj_ca_spec ∗ts, go_real t, go_traj_ca_spec ∗pts)

  go_traj_ca_extend() takes a time 't' for the desired time to finish the motion, and extends the constant-speed section so that it stops then.
- go_result go_traj_ca_interp (const go_traj_ca_spec ∗ts, go_real t, go_traj_interp_spec ∗ti)

  go_traj_ca_interp() takes a go_traj_ca_spec and interpolates the d-v-a values for the given time t, storing the d-v-a values in ti.
- go_result go_traj_cj_generate (go_real jrk, go_real deltjrk, go_real deltacc, go_real deltvel, go_traj_cj_spec ∗pts)

  go_traj_cj_generate() takes a jerk value, and intervals for the jerk period, accel period and cruise period, and fills in the go_traj_cj_spec with the interval parameters.
- go_result go_traj_cj_compute (go_real d, go_real v, go_real a, go_real j, go_traj_cj_spec ∗pts)

  go_traj_cj_compute() takes values for distance 'd' to move, max velocity 'v' to limit if necessary, max accel 'a' to limit if necessary, and constant jerk 'j', and fills in the go_traj_cj_spec with the interval parameters.
- go_result go_traj_cj_scale (const go_traj_cj_spec ∗ts, go_real t, go_traj_cj_spec ∗pts)

  go_traj_cj_scale() takes a time 't' for the desired time of the motion, and scales the times and motion params so that the total distance remains the same and everything else is in proportion
- go_result go_traj_cj_stop (const go_traj_cj_spec ∗ts, go_real t, go_traj_cj_spec ∗pts)

  go_traj_cj_stop() takes a time 't' for the desired time to begin stopping, and recomputes the times so that the move will stop as soon as possible during subsequent interps.
- go_result go_traj_cj_extend (const go_traj_cj_spec ∗ts, go_real t, go_traj_cj_spec ∗pts)

go_traj_cj_extend() takes a time 't' for the desired time to finish the motion, and extends the constant-speed section so that it stops then.

- go_result go_traj_cj_interp (const go_traj_cj_spec ∗ts, go_real t, go_traj_interp_spec ∗ti)

  go_traj_cj_interp() takes a go_traj_cj_spec and interpolates the d-v-a-j values for the given time t, storing the d-v-a-j values in ti.

- go_result go_traj_cj_compute_the_rest (go_traj_cj_spec ∗pts)

  ! Expects pts attributes dtend, jt0, at1, vt3, t1, t2 and t3 to be already filled in from previous calls to one of the four go_traj_cj_compute_tees functions and go_traj_cj_compute.

- go_result go_traj_cj_compute_tees_na_nc (go_traj_cj_spec ∗pts)

  ! Computes the trajectory defining times t1, t2 and t4 for a motion with no acceleration or cruise phase, given pts filled in with dtend and jt0.

- go_result go_traj_cj_compute_tees_a_nc (go_traj_cj_spec ∗pts)

  ! Computes the trajectory defining times t1, t2 and t4 for a motion with acceleration but no cruise phase, given pts filled in with dtend, jt0 and at1.

- go_result go_traj_cj_compute_tees_na_c (go_traj_cj_spec ∗pts)

  ! Computes the trajectory defining times t1, t2 and t4 for a motion with no acceleration but a cruise phase, given pts filled in with dtend, jt0 and vt3.

- go_result go_traj_cj_compute_tees_a_c (go_traj_cj_spec ∗pts)

  ! Computes the trajectory defining times t1, t2 and t4 for a motion with no acceleration but a cruise phase, given pts filled in with dtend, jt0, at1 and vt3.

6.1.1 Typedef Documentation

6.1.1.1 typedef go_real gomotion::go_vector

Declare a matrix variable *m* with *rows* rows and *cols* columns. Allocates *rows* X *columns* of space in *mspace*.

6.1.1.2 typedef sensor_msgs::JointState_<std::allocator<void> > gomotion::JointState

6.1.2 Enumeration Type Documentation

6.1.2.1 anonymous enum

How many coefficients we support, one more than max polynomial degree.

Enumerator

COEFF_MAX

6.1.2.2 anonymous enum

Types of link parameter representations

Enumerator

GO_LINK_DH	for Denavit-Hartenberg params
GO_LINK_PK	for parallel kinematics
GO_LINK_PP	for serial kinematics

6.1.2.3 anonymous enum

Enumerator

GO_MOTION_NONE types of motion queueing done

GO_MOTION_JOINT

GO_MOTION_UJOINT

GO_MOTION_WORLD

GO_MOTION_LINEAR these are used to further specify types of world motion

GO_MOTION_CIRCULAR

6.1.3 Function Documentation

6.1.3.1 go_result gomotion::go_acoses (go_real *c*, go_real ∗ *acp*, go_real ∗ *acn*)

Double-valued inverse cosine, giving both solutions

6.1.3.2 go_result gomotion::go_asines (go_real *s*, go_real ∗ *asp*, go_real ∗ *asn*)

Double-valued inverse sine, giving both solutions

6.1.3.3 go_result gomotion::go_atans (go_real *t*, go_real ∗ *atp*, go_real ∗ *atn*)

Double-valued inverse tangent, giving both solutions

6.1.3.4 go_result gomotion::go_cart_cart_add (const go_cart ∗ *v1*, const go_cart ∗ *v2*, go_cart ∗ *vout*)

6.1.3.5 go_result gomotion::go_cart_cart_angle (const go_cart ∗ *v1*, const go_cart ∗ *v2*, go_real ∗ *a*)

6.1.3.6 go_flag gomotion::go_cart_cart_compare (const go_cart ∗ *v1*, const go_cart ∗ *v2*)

6.1.3.7 go_result gomotion::go_cart_cart_cross (const go_cart ∗ *v1*, const go_cart ∗ *v2*, go_cart ∗ *vout*)

6.1.3.8 go_result gomotion::go_cart_cart_disp (const go_cart ∗ *v1*, const go_cart ∗ *v2*, go_real ∗ *disp*)

Places the Cartesian displacement between two vectors *v1* and *v2* in *disp*, returning *GO_RESULT_OK*.

6.1.3.9 go_result gomotion::go_cart_cart_dot (const go_cart ∗ *v1*, const go_cart ∗ *v2*, go_real ∗ *d*)

6.1.3.10 go_flag gomotion::go_cart_cart_par (const go_cart ∗ *v1*, const go_cart ∗ *v2*)

6.1.3.11 go_flag gomotion::go_cart_cart_perp (const go_cart ∗ *v1*, const go_cart ∗ *v2*)

6.1.3.12 go_result gomotion::go_cart_cart_pose (const go_cart ∗ *v1*, const go_cart ∗ *v2*, go_cart ∗ *v1c*, go_cart ∗ *v2c*, go_integer *num*, go_pose ∗ *pout*)

Given an array of Cartesian points measured in one coordinate system, and an associated array measured in another coordinate system, returns the best-fit transform that takes points in the first coordinate system to their representation in the second coordinate system.

Parameters

v1	An array of Cartesian points in one coordinate system
v2	An array of the same Cartesian points in another coordinate system
v1c	A scratch array of the same size as *v1* needed for calculation.
v2c	A scratch array of the same size as *v2* needed for calculation.
num	The number of points in the *v1* and *v2* arrays, which must be the same size.
pout	A pointer to the calculated best-fit pose filled in by this function.

6.1.3.13 go_result gomotion::go_cart_cart_proj (const go_cart ∗ *v1*, const go_cart ∗ *v2*, go_cart ∗ *vout*)

Project vector *v1* onto *v2*, with the resulting vector placed into *vout*. Returns GO_RESULT_OK if it can be done, otherwise something else.

6.1.3.14 go_result gomotion::go_cart_cart_rot (const go_cart ∗ *v1*, const go_cart ∗ *v2*, go_quat ∗ *quat*)

Given two non-zero vectors *v1* and *v2*, fill in *quat* with the minimum rotation that brings *v1* to *v2*.

6.1.3.15 go_result gomotion::go_cart_cart_sub (const go_cart ∗ *v1*, const go_cart ∗ *v2*, go_cart ∗ *vout*)

6.1.3.16 go_result gomotion::go_cart_centroid (const go_cart ∗ *varray*, go_integer *num*, go_cart ∗ *centroid*)

6.1.3.17 go_result gomotion::go_cart_centroidize (const go_cart ∗ *vinarray*, go_integer *num*, go_cart ∗ *centroid*, go_cart ∗ *voutarray*)

6.1.3.18 go_result gomotion::go_cart_cyl_convert (const go_cart ∗ *v*, go_cyl ∗ *c*)

6.1.3.19 go_result gomotion::go_cart_is_norm (const go_cart ∗ *v*)

6.1.3.20 go_result gomotion::go_cart_mag (const go_cart ∗ *v*, go_real ∗ *d*)

6.1.3.21 go_result gomotion::go_cart_magsq (const go_cart ∗ *v*, go_real ∗ *d*)

6.1.3.22 go_result gomotion::go_cart_neg (const go_cart ∗ *v1*, go_cart ∗ *vout*)

6.1.3.23 go_result gomotion::go_cart_normal (const go_cart ∗ *v*, go_cart ∗ *vout*)

go_cart_normal finds one of the infinite vectors perpendicular to *v*, putting the result in *vout*.

6.1.3.24 go_result gomotion::go_cart_plane_proj (const go_cart ∗ *v*, const go_cart ∗ *normal*, go_cart ∗ *vout*)

6.1.3.25 go_result gomotion::go_cart_rvec_convert (const go_cart ∗ *cart*, go_rvec ∗ *rvec*)

go_cart_rvec_convert and go_rvec_cart_convert convert between Cartesian vectors and rotation vectors. The conversion is trivial but keeps types distinct.

6.1.3.26 go_result gomotion::go_cart_scale_mult (const go_cart ∗ *v1*, go_real *d*, go_cart ∗ *vout*)

6.1.3.27 go_result gomotion::go_cart_sph_convert (const go_cart ∗ *v*, go_sph ∗ *s*)

6.1.3.28 **go_result** gomotion::go_cart_trilaterate (const go_cart ∗ *c1,* const go_cart ∗ *c2,* const go_cart ∗ *c3,* **go_real** *l1,* **go_real** *l2,* **go_real** *l3,* go_cart ∗ *out1,* go_cart ∗ *out2*)

Returns the Cartesian point *p* whose distances from three other points *c1*, *c2* and *c3* are *l1*, *l2* and *l3*, respectively. In general there are 0, 1 or two points possible. If no point is possible, this returns GO_RESULT_ERROR, otherwise the points are returned in *p1* and *p2*, which may be the same point.

6.1.3.29 **go_result** gomotion::go_cart_unit (const go_cart ∗ *v,* go_cart ∗ *vout*)

6.1.3.30 **go_result** gomotion::go_cart_vector_convert (const go_cart ∗ *c,* **go_real** ∗ *v*)

6.1.3.31 **go_cart** gomotion::go_cart_zero (void)

Returns the zero vector.

6.1.3.32 **go_real** gomotion::go_cbrt (**go_real** *x*)

Returns the cube root of *x*.

6.1.3.33 **go_complex** gomotion::go_complex_add (go_complex *z1,* go_complex *z2*)

6.1.3.34 **go_real** gomotion::go_complex_arg (go_complex *z*)

6.1.3.35 void gomotion::go_complex_cbrt (go_complex *z,* go_complex ∗ *z1,* go_complex ∗ *z2,* go_complex ∗ *z3*)

6.1.3.36 **go_complex** gomotion::go_complex_div (go_complex *z1,* go_complex *z2,* **go_result** ∗ *result*)

6.1.3.37 **go_complex** gomotion::go_complex_inv (go_complex *z,* **go_result** ∗ *result*)

6.1.3.38 **go_real** gomotion::go_complex_mag (go_complex *z*)

6.1.3.39 **go_real** gomotion::go_complex_magsq (go_complex *z*)

6.1.3.40 **go_complex** gomotion::go_complex_mult (go_complex *z1,* go_complex *z2*)

6.1.3.41 **go_complex** gomotion::go_complex_scale (go_complex *z,* **go_real** *scale*)

6.1.3.42 **go_complex** gomotion::go_complex_sq (go_complex *z*)

6.1.3.43 void gomotion::go_complex_sqrt (go_complex *z,* go_complex ∗ *z1,* go_complex ∗ *z2*)

6.1.3.44 **go_complex** gomotion::go_complex_sub (go_complex *z1,* go_complex *z2*)

6.1.3.45 **go_result** gomotion::go_cubic_solve (const go_cubic ∗ *cub,* go_complex ∗ *z1,* go_complex ∗ *z2,* go_complex ∗ *z3*)

6.1.3.46 **go_result** gomotion::go_cyl_cart_convert (const go_cyl ∗ *c,* go_cart ∗ *v*)

6.1.3.47 **go_result** gomotion::go_cyl_sph_convert (const go_cyl ∗ *c,* go_sph ∗ *s*)

6.1.3.48 go_result gomotion::go_dh_hom_convert (const go_dh ∗ *dh*, go_hom ∗ *hom*)

Converts DH parameters in *dh* to their transform equivalent, stored in *hom*.

6.1.3.49 go_result gomotion::go_dh_pose_convert (const go_dh ∗ *dh*, go_pose ∗ *pose*)

Converts DH parameters in *dh* to their pose equivalent, stored in *pose*.

6.1.3.50 go_real gomotion::go_get_singular_epsilon (void)

6.1.3.51 go_result gomotion::go_hom_dh_convert (const go_hom ∗ *hom*, go_dh ∗ *dh*)

Counterpart to go_pose_dh_convert, for transforms.

6.1.3.52 go_result gomotion::go_hom_hom_mult (const go_hom ∗ *h1*, const go_hom ∗ *h2*, go_hom ∗ *hout*)

6.1.3.53 go_result gomotion::go_hom_inv (const go_hom ∗ *h1*, go_hom ∗ *h2*)

6.1.3.54 go_result gomotion::go_hom_pose_convert (const go_hom ∗ *h*, go_pose ∗ *p*)

6.1.3.55 go_result gomotion::go_line_evaluate (const go_line ∗ *line*, go_real *d*, go_cart ∗ *point*)

Fills in *point* with the point located distance *d* along *line*

6.1.3.56 go_result gomotion::go_line_from_planes (const go_plane ∗ *plane1*, const go_plane ∗ *plane2*, go_line ∗ *line*)

Fill in *line* with the intersection of the two planes. Returns GO_RESULT_OK if the planes are not parallel, otherwise GO_RESULT_ERROR.

6.1.3.57 go_result gomotion::go_line_from_point_direction (const go_cart ∗ *point*, const go_cart ∗ *direction*, go_line ∗ *line*)

Fills in *line* given *point* and *direction*. Returns GO_RESULT_OK if *direction* is non-zero, otherwise GO_RESULT_ERROR.

6.1.3.58 go_result gomotion::go_line_from_points (const go_cart ∗ *point1*, const go_cart ∗ *point2*, go_line ∗ *line*)

Fills in *line* given two points. Returns GO_RESULT_OK if the points are different, otherwise GO_RESULT_ERROR.

6.1.3.59 go_flag gomotion::go_line_line_compare (const go_line ∗ *line1*, const go_line ∗ *line2*)

Returns non-zero if the lines are the same, otherwise zero.

6.1.3.60 go_result gomotion::go_line_plane_intersect (const go_line ∗ *line*, const go_plane ∗ *plane*, go_cart ∗ *point*, go_real ∗ *distance*)

Fills in *point* with the intersection point of *line* with *plane*, and *distance* with the distance along the line to the intersection point. Returns GO_RESULT_ERROR if the line is parallel to the plane and not lying in the plane, otherwise GO_RESULT_OK.

6.1.3.61 go_result gomotion::go_line_plane_proj (const go_line ∗ *line,* const go_plane ∗ *plane,* go_line ∗ *proj*)

Fills in *proj* with the projection of *line* onto *plane*

6.1.3.62 go_result gomotion::go_linear_cos_sin_solve (go_real *a,* go_real *b,* go_real ∗ *th1,* go_real ∗ *th2*)

Solves *cos* theta + **b** sin theta = 1 for theta, two solutions

6.1.3.63 go_result gomotion::go_link_joint_set (const go_link ∗ *link,* go_real *joint,* go_link ∗ *linkout*)

Fixes the link in *link* to its value when the joint variable is *joint*, storing the result in *linkout*.

6.1.3.64 go_result gomotion::go_link_pose_build (const go_link ∗ *links,* go_integer *num,* go_pose ∗ *pose*)

Takes the link description of the device in *links*, and the number of these in *num*, and builds the pose of the device and stores in *pose*. *links* should have the value of the free link parameter filled in with the current joint value, e.g., with a prior call to go_link_joint_set.

6.1.3.65 go_result gomotion::go_mat3_inv (go_real *a[3][3],* go_real *ainv[3][3]*)

6.1.3.66 go_result gomotion::go_mat3_mat3_mult (go_real *a[3][3],* go_real *b[3][3],* go_real *axb[3][3]*)

6.1.3.67 go_result gomotion::go_mat3_vec3_mult (go_real *a[3][3],* go_real *v[3],* go_real *axv[3]*)

6.1.3.68 go_result gomotion::go_mat4_inv (go_real *a[4][4],* go_real *ainv[4][4]*)

6.1.3.69 go_result gomotion::go_mat4_mat4_mult (go_real *a[4][4],* go_real *b[4][4],* go_real *axb[4][4]*)

6.1.3.70 go_result gomotion::go_mat4_vec4_mult (go_real *a[4][4],* go_real *v[4],* go_real *axv[4]*)

6.1.3.71 go_result gomotion::go_mat6_inv (go_real *a[6][6],* go_real *ainv[6][6]*)

Given a 6x6 matrix *a*, computes the inverse and returns it in *ainv*. Leaves *a* untouched. Returns GO_RESULT_OK if there is an inverse, else GO_RESULT_SINGULAR if the matrix is singular.

6.1.3.72 go_result gomotion::go_mat6_mat6_mult (go_real *a[6][6],* go_real *b[6][6],* go_real *axb[6][6]*)

Given two 6x6 matrices *a* and *b*, multiplies them and returns the result in *axb*. Leaves *a* and *b* untouched. Returns GO_RESULT_OK.

6.1.3.73 go_result gomotion::go_mat6_transpose (go_real *a[6][6],* go_real *at[6][6]*)

Given a 6x6 matrix *a*, generates the transpose and returns it in *at*. Leaves *a* untouched. Returns GO_RESULT_OK.

6.1.3.74 go_result gomotion::go_mat6_vec6_mult (go_real *a[6][6],* go_real *v[6],* go_real *axv[6]*)

Given a 6x6 matrix *a* and a 6x1 vector *v*, multiplies them and returns the result in *axv*. Leaves *a* and *v* untouched. Returns GO_RESULT_OK.

6.1.3.75 go_result gomotion::go_mat_cart_mult (const go_mat * *m*, const go_cart * *v*, go_cart * *vout*)

6.1.3.76 go_result gomotion::go_mat_inv (const go_mat * *m*, go_mat * *mout*)

6.1.3.77 go_flag gomotion::go_mat_is_norm (const go_mat * *m*)

6.1.3.78 go_result gomotion::go_mat_mat_mult (const go_mat * *m1*, const go_mat * *m2*, go_mat * *mout*)

6.1.3.79 go_result gomotion::go_mat_matrix_convert (const go_mat * *mat*, go_matrix * *matrix*)

6.1.3.80 go_result gomotion::go_mat_norm (const go_mat * *m*, go_mat * *mout*)

Normalizes rotation matrix *m* so that all columns are mutually perpendicular unit vectors, placing the result in *mout*.

6.1.3.81 go_result gomotion::go_mat_quat_convert (const go_mat * *m*, go_quat * *q*)

6.1.3.82 go_result gomotion::go_mat_rpy_convert (const go_mat * *m*, go_rpy * *rpy*)

6.1.3.83 go_result gomotion::go_mat_rvec_convert (const go_mat * *m*, go_rvec * *r*)

6.1.3.84 go_result gomotion::go_mat_uxz_convert (const go_mat * *mat*, go_uxz * *uxz*)

6.1.3.85 go_result gomotion::go_mat_xyz_convert (const go_mat * *m*, go_xyz * *xyz*)

6.1.3.86 go_result gomotion::go_mat_zyx_convert (const go_mat * *m*, go_zyx * *zyx*)

6.1.3.87 go_result gomotion::go_mat_zyz_convert (const go_mat * *m*, go_zyz * *zyz*)

6.1.3.88 go_result gomotion::go_matrix_inv (const go_matrix * *m*, go_matrix * *minv*)

6.1.3.89 go_result gomotion::go_matrix_matrix_add (const go_matrix * *a*, const go_matrix * *b*, go_matrix * *apb*)

6.1.3.90 go_result gomotion::go_matrix_matrix_copy (const go_matrix * *src*, go_matrix * *dst*)

6.1.3.91 go_result gomotion::go_matrix_matrix_mult (const go_matrix * *a*, const go_matrix * *b*, go_matrix * *ab*)

6.1.3.92 go_result gomotion::go_matrix_transpose (const go_matrix * *a*, go_matrix * *at*)

6.1.3.93 go_result gomotion::go_matrix_vector_cross (const go_matrix * *a*, const go_vector * *v*, go_matrix * *axv*)

The matrix-vector cross product is a matrix of the same dimension, whose columns are the column-wise cross products of the matrix and the vector. The matrices must be 3xN, the vector 3x1.

6.1.3.94 go_result gomotion::go_matrix_vector_mult (const go_matrix * *a*, const go_vector * *v*, go_vector * *axv*)

6.1.3.95 go_result gomotion::go_plane_evaluate (const go_plane * *plane*, go_real *u*, go_real *v*, go_cart * *point*)

Fills in *point* with the point located distances *u* and *v* along some othogonal planar coordinate system in *plane*

6.1.3.96 **go_result** gomotion::go_plane_from_abcd (**go_real** *A,* **go_real** *B,* **go_real** *C,* **go_real** *D,* go_plane ∗ *plane*)

Fills in *plane* given the A, B, C and D values in the canonical form Ax + By + Cz + D = 0. Returns GO_RESULT_OK if not all of A, B and C are zero, otherwise GO_RESULT_ERROR.

6.1.3.97 **go_result** gomotion::go_plane_from_point_line (const go_cart ∗ *point,* const go_line ∗ *line,* go_plane ∗ *plane*)

Fills in *plane* given a *point* on the plane and a *line* in the plane. Returns GO_RESULT_OK if the point is not on the line, GO_RESULT_ERROR otherwise.

6.1.3.98 **go_result** gomotion::go_plane_from_point_normal (const go_cart ∗ *point,* const go_cart ∗ *normal,* go_plane ∗ *plane*)

Fills in *plane* give a *point* on the plane and the normal *direction*.

6.1.3.99 **go_result** gomotion::go_plane_from_points (const go_cart ∗ *point1,* const go_cart ∗ *point2,* const go_cart ∗ *point3,* go_plane ∗ *plane*)

Fills in *plane* given three points. Returns GO_RESULT_OK if the points are distinct, otherwise GO_RESULT_ERROR.

6.1.3.100 **go_flag** gomotion::go_plane_plane_compare (const go_plane ∗ *plane1,* const go_plane ∗ *plane2*)

Returns non-zero if the planes are coincident and have the same normal direction, otherwise zero.

6.1.3.101 **go_result** gomotion::go_point_line_distance (const go_cart ∗ *point,* const go_line ∗ *line,* **go_real** ∗ *distance*)

Fills in *distance* with the distance from *point* to *line*

6.1.3.102 **go_result** gomotion::go_point_line_proj (const go_cart ∗ *point,* const go_line ∗ *line,* go_cart ∗ *pout*)

Fills in *pout* with the nearest point on *line* to *point*

6.1.3.103 **go_result** gomotion::go_point_plane_distance (const go_cart ∗ *point,* const go_plane ∗ *plane,* **go_real** ∗ *distance*)

Fills in the *distance* from the *point* to the *plane*.

6.1.3.104 **go_result** gomotion::go_point_plane_proj (const go_cart ∗ *point,* const go_plane ∗ *plane,* go_cart ∗ *proj*)

Fills in *proj* with the projection of *point* onto *plane*

6.1.3.105 **go_result** gomotion::go_pose_cart_mult (const go_pose ∗ *p1,* const go_cart ∗ *v2,* go_cart ∗ *vout*)

6.1.3.106 **go_result** gomotion::go_pose_dh_convert (const go_pose ∗ *pose,* go_dh ∗ *dh*)

Converts *pose* to the equivalent DH parameters, stored in *dh*. Warning! Conversion from these DH parameters back to a pose via *go_dh_pose_convert* will NOT in general result in the same pose. Poses have 6 degrees of freedom, DH parameters have 4, and conversion to DH parameters loses some information. The source of this information loss is the convention imposed on DH parameters for choice of X-Y-Z axis directions. With poses, there is no such convention, and poses are thus freer than DH parameters.

6.1.3.107 go_result gomotion::go_pose_hom_convert (const go_pose ∗ *p*, go_hom ∗ *h*)

6.1.3.108 go_pose gomotion::go_pose_identity (void)

Returns the identity pose, no translation or rotation.

6.1.3.109 go_result gomotion::go_pose_inv (const go_pose ∗ *p1*, go_pose ∗ *p2*)

6.1.3.110 go_flag gomotion::go_pose_pose_compare (const go_pose ∗ *p1*, const go_pose ∗ *p2*)

6.1.3.111 go_result gomotion::go_pose_pose_interp (go_real *t1*, const go_pose ∗ *p1*, go_real *t2*, const go_pose ∗ *p2*, go_real *t3*, go_pose ∗ *p3*)

Given two times *t1* and *t2*, and associated poses *p1* and *p2*, interpolates (or extrapolates) to find pose *p3* at time *t3*. The result is stored in *p3*. Returns GO_RESULT_OK if *t1* and *t2* are distinct and *p1* and *p2* are valid poses, otherwise it can't interpolate and returns a relevant error.

6.1.3.112 go_result gomotion::go_pose_pose_mult (const go_pose ∗ *p1*, const go_pose ∗ *p2*, go_pose ∗ *pout*)

6.1.3.113 go_result gomotion::go_pose_scale_mult (const go_pose ∗ *p1*, go_real *s*, go_pose ∗ *pout*)

6.1.3.114 go_pose gomotion::go_pose_this (go_real *x*, go_real *y*, go_real *z*, go_real *rs*, go_real *rx*, go_real *ry*, go_real *rz*)

Convenience function that returns a *go_pose* given individual elements.

6.1.3.115 go_result gomotion::go_pose_vel_mult (const go_pose ∗ *pose*, const go_vel ∗ *vel*, go_vel ∗ *out*)

Given *pose* transformation from frame A to B, and a velocity *vel* in frame A, transform the velocity into frame B and place in *out*.

6.1.3.116 go_result gomotion::go_quadratic_solve (const go_quadratic ∗ *quad*, go_complex ∗ *z1*, go_complex ∗ *z2*)

6.1.3.117 go_result gomotion::go_quartic_solve (const go_quartic ∗ *quart*, go_complex ∗ *z1*, go_complex ∗ *z2*, go_complex ∗ *z3*, go_complex ∗ *z4*)

6.1.3.118 go_result gomotion::go_quat_cart_mult (const go_quat ∗ *q1*, const go_cart ∗ *v2*, go_cart ∗ *vout*)

6.1.3.119 go_quat gomotion::go_quat_identity (void)

Returns the identity (zero) quaternion, i.e., no rotation.

6.1.3.120 go_result gomotion::go_quat_inv (const go_quat ∗ *q1*, go_quat ∗ *qout*)

6.1.3.121 go_flag gomotion::go_quat_is_norm (const go_quat ∗ *q1*)

6.1.3.122 go_result gomotion::go_quat_mag (const go_quat ∗ *quat,* go_real ∗ *d*)

6.1.3.123 go_result gomotion::go_quat_mat_convert (const go_quat ∗ *q,* go_mat ∗ *m*)

6.1.3.124 go_result gomotion::go_quat_matrix_convert (const go_quat ∗ *quat,* go_matrix ∗ *matrix*)

6.1.3.125 go_result gomotion::go_quat_norm (const go_quat ∗ *q1,* go_quat ∗ *qout*)

6.1.3.126 go_flag gomotion::go_quat_quat_compare (const go_quat ∗ *q1,* const go_quat ∗ *q2*)

6.1.3.127 go_result gomotion::go_quat_quat_mult (const go_quat ∗ *q1,* const go_quat ∗ *q2,* go_quat ∗ *qout*)

6.1.3.128 go_result gomotion::go_quat_rpy_convert (const go_quat ∗ *q,* go_rpy ∗ *rpy*)

6.1.3.129 go_result gomotion::go_quat_rvec_convert (const go_quat ∗ *q,* go_rvec ∗ *r*)

6.1.3.130 go_result gomotion::go_quat_scale_mult (const go_quat ∗ *q,* go_real *s,* go_quat ∗ *qout*)

6.1.3.131 go_result gomotion::go_quat_unit (const go_quat ∗ *q,* go_quat ∗ *qout*)

go_quat_unit takes a quaternion rotation *q* and converts it into a unit rotation about the same axis, *qout*.

6.1.3.132 go_result gomotion::go_quat_xyz_convert (const go_quat ∗ *,* go_xyz ∗)

6.1.3.133 go_result gomotion::go_quat_zyx_convert (const go_quat ∗ *q,* go_zyx ∗ *zyx*)

6.1.3.134 go_result gomotion::go_quat_zyz_convert (const go_quat ∗ *q,* go_zyz ∗ *zyz*)

6.1.3.135 go_result gomotion::go_rpy_cart_mult (const go_rpy ∗ *rpy,* const go_cart ∗ *in,* go_cart ∗ *out*)

6.1.3.136 go_result gomotion::go_rpy_mat_convert (const go_rpy ∗ *rpy,* go_mat ∗ *m*)

6.1.3.137 go_result gomotion::go_rpy_quat_convert (const go_rpy ∗ *rpy,* go_quat ∗ *quat*)

6.1.3.138 go_result gomotion::go_rpy_rvec_convert (const go_rpy ∗ *rpy,* go_rvec ∗ *rvec*)

6.1.3.139 go_result gomotion::go_rpy_xyz_convert (const go_rpy ∗ *,* go_xyz ∗)

6.1.3.140 go_result gomotion::go_rpy_zyx_convert (const go_rpy ∗ *rpy,* go_zyx ∗ *zyx*)

6.1.3.141 go_result gomotion::go_rpy_zyz_convert (const go_rpy ∗ *rpy,* go_zyz ∗ *zyz*)

6.1.3.142 go_result gomotion::go_rvec_cart_convert (const go_rvec ∗ *rvec,* go_cart ∗ *cart*)

6.1.3.143 go_result gomotion::go_rvec_mat_convert (const go_rvec ∗ *r,* go_mat ∗ *m*)

6.1.3.144 go_result gomotion::go_rvec_quat_convert (const go_rvec ∗ *r,* go_quat ∗ *q*)

6.1.3.145 go_result gomotion::go_rvec_rpy_convert (const go_rvec ∗ *r,* go_rpy ∗ *rpy*)

6.1.3.146 go_flag gomotion::go_rvec_rvec_compare (const go_rvec ∗ *r1,* const go_rvec ∗ *r2*)

6.1.3.147 go_result gomotion::go_rvec_scale_mult (const go_rvec ∗ *r*, go_real *s*, go_rvec ∗ *rout*)

6.1.3.148 go_result gomotion::go_rvec_xyz_convert (const go_rvec ∗ , go_xyz ∗)

6.1.3.149 go_result gomotion::go_rvec_zyx_convert (const go_rvec ∗ *rvec*, go_zyx ∗ *zyx*)

6.1.3.150 go_result gomotion::go_rvec_zyz_convert (const go_rvec ∗ *rvec*, go_zyz ∗ *zyz*)

6.1.3.151 go_result gomotion::go_set_singular_epsilon (go_real *epsilon*)

6.1.3.152 void gomotion::go_sincos (go_real *x*, go_real ∗ *s*, go_real ∗ *c*)

Returns the sine and cosine of *x* (in radians) in *s* and *c*, respectively. Implemented as a single call when supported, to speed up the calculation of the two values.

6.1.3.153 go_result gomotion::go_sph_cart_convert (const go_sph ∗ *s*, go_cart ∗ *v*)

6.1.3.154 go_result gomotion::go_sph_cyl_convert (const go_sph ∗ *s*, go_cyl ∗ *c*)

6.1.3.155 go_result gomotion::go_traj_ca_compute (go_real *d*, go_real *v*, go_real *a*, go_traj_ca_spec ∗ *pts*) [inline]

go_traj_ca_compute() takes values for distance 'd' to move, max velocity 'v' to limit if necessary, and constant accel 'a', and fills in the go_traj_ca_spec with the interval parameters.

cruise phase

no cruise phase

cruise phase

no cruise phase

6.1.3.156 go_result gomotion::go_traj_ca_extend (const go_traj_ca_spec ∗ *ts*, go_real *t*, go_traj_ca_spec ∗ *pts*) [inline]

go_traj_ca_extend() takes a time 't' for the desired time to finish the motion, and extends the constant-speed section so that it stops then.

The time must be shorter than the original time, and longer than the fastest stopping time.

6.1.3.157 go_result gomotion::go_traj_ca_generate (go_real *acc*, go_real *deltacc*, go_real *deltvel*, go_traj_ca_spec ∗ *pts*) [inline]

go_traj_ca_generate() takes an accel value, and intervals for the accel period and cruise period, and fills in the go_traj-_ca_spec with the interval parameters.

constant acceleration functions

This is useful for generating test cases. any time intervals less than 0. mean 0.

compute intermediate values for end of each phase

any time intervals less than 0. mean 0.

compute intermediate values for end of each phase

6.1.3.158 go_result gomotion::go_traj_ca_interp (const go_traj_ca_spec ∗ *ts*, go_real *t*, go_traj_interp_spec ∗ *ti*) [inline]

go_traj_ca_interp() takes a go_traj_ca_spec and interpolates the d-v-a values for the given time t, storing the d-v-a values in ti.

run interpolation on each phase for each motion parameter, using

d = d0 + v0 t + 1/2 a0 t^2 v = v0 + a0 t a = a0 j = 0

where d0, v0, a0 are the initial values for each phase

6.1.3.159 go_result gomotion::go_traj_ca_scale (const go_traj_ca_spec ∗ *ts*, go_real *t*, go_traj_ca_spec ∗ *pts*) [inline]

go_traj_ca_scale() takes a time 't' for the desired time of the motion, and scales the times and motion params so that the total distance remains the same and everything else is in proportion
can't shrink motion

```
this just adds a cruise phase to stretch the time, and reduces
```

the acc value accordingly
can't shrink motion

```
this just adds a cruise phase to stretch the time, and reduces
```

the acc value accordingly

6.1.3.160 go_result gomotion::go_traj_ca_stop (const go_traj_ca_spec ∗ *ts*, go_real *t*, go_traj_ca_spec ∗ *pts*) [inline]

go_traj_ca_stop() takes a time 't' for the desired time to begin stopping, and recomputes the times so that the move will stop as soon as possible during subsequent interps.

stage I

null stage II, same as I

stage III

stage I unchanged

stage II

stage III

already in stage III, do nothing

stage I

null stage II, same as I

stage III

stage I unchanged

stage II

stage III

already in stage III, do nothing

6.1.3.161 go_result gomotion::go_traj_cj_compute (go_real *d*, go_real *v*, go_real *a*, go_real *j*, go_traj_cj_spec ∗ *pts*) [inline]

go_traj_cj_compute() takes values for distance 'd' to move, max velocity 'v' to limit if necessary, max accel 'a' to limit if necessary, and constant jerk 'j', and fills in the go_traj_cj_spec with the interval parameters.

! Given a total move distance *d*, maximum peak speed *v*, maximum peak acceleration *a* and jerk *j*, compute the times for each of the seven phases (jerk, accel, dejerk, cruise, dejerk, decel and jerk), and the associated cumulative distances, instantaneous speeds and accelerations.

The resulting structure *pts* will be used by the constant-jerk interpolater *go_traj_cj_interp* repeatedly when evaluating the motion along this trajectory. fill the targets in, and they will be recomputed if needed

accel phase

cruise phase

no cruise phase

no accel phase

cruise phase

no cruise phase

fill the targets in, and they will be recomputed if needed

accel phase

cruise phase

no cruise phase

no accel phase

cruise phase

no cruise phase

6.1.3.162 go_result gomotion::go_traj_cj_compute_tees_a_c (go_traj_cj_spec ∗ *pts*) [inline]

! Computes the trajectory defining times *t1*, *t2* and *t4* for a motion with no acceleration but a cruise phase, given *pts* filled in with *dtend*, *jt0*, at1 and *vt3*.

A subsequent call to *go_traj_cj_compute_the_rest* will fill in the remaining parameters which will be used repeatedly by *go_traj_cj_interp*.

6.1.3.163 go_result gomotion::go_traj_cj_compute_tees_a_nc (go_traj_cj_spec ∗ *pts*) [inline]

! Computes the trajectory defining times *t1*, *t2* and *t4* for a motion with acceleration but no cruise phase, given *pts* filled in with *dtend*, *jt0* and *at1*.

A subsequent call to *go_traj_cj_compute_the_rest* will fill in the remaining parameters which will be used repeatedly by *go_traj_cj_interp*.

6.1.3.164 go_result gomotion::go_traj_cj_compute_tees_na_c (go_traj_cj_spec ∗ *pts*) [inline]

! Computes the trajectory defining times *t1*, *t2* and *t4* for a motion with no acceleration but a cruise phase, given *pts* filled in with *dtend*, *jt0* and *vt3*.

A subsequent call to *go_traj_cj_compute_the_rest* will fill in the remaining parameters which will be used repeatedly by *go_traj_cj_interp*.

6.1.3.165 go_result gomotion::go_traj_cj_compute_tees_na_nc (go_traj_cj_spec ∗ *pts*) [inline]

! Computes the trajectory defining times *t1*, *t2* and *t4* for a motion with no acceleration or cruise phase, given *pts* filled in with *dtend* and *jt0*.

A subsequent call to *go_traj_cj_compute_the_rest* will fill in the remaining parameters which will be used repeatedly by *go_traj_cj_interp*.

6.1.3.166 go_result gomotion::go_traj_cj_compute_the_rest (go_traj_cj_spec ∗ *pts*) [inline]

! Expects *pts* attributes *dtend*, *jt0*, *at1*, *vt3*, *t1*, *t2* and *t3* to be already filled in from previous calls to one of the four *go_traj_cj_compute_tees* functions and *go_traj_cj_compute*.

Fills in all the remaining values in *pts:* the times for each of the seven phases, the associated cumulative distances, and the instantaneous speeds and accelerations.

6.1.3.167 go_result gomotion::go_traj_cj_extend (const go_traj_cj_spec ∗ *ts,* go_real *t,* go_traj_cj_spec ∗ *pts*) [inline]

go_traj_cj_extend() takes a time 't' for the desired time to finish the motion, and extends the constant-speed section so that it stops then.

The time must be shorter than the original time, and longer than the fastest stopping time.

6.1.3.168 go_result gomotion::go_traj_cj_generate (go_real *jrk,* go_real *deltjrk,* go_real *deltacc,* go_real *deltvel,* go_traj_cj_spec ∗ *pts*) [inline]

go_traj_cj_generate() takes a jerk value, and intervals for the jerk period, accel period and cruise period, and fills in the go_traj_cj_spec with the interval parameters.

constant jerk functions

This is useful for generating test cases. any time intervals less than 0. mean 0.

compute intermediate values for end of each phase

any time intervals less than 0. mean 0.

compute intermediate values for end of each phase

6.1.3.169 go_result gomotion::go_traj_cj_interp (const go_traj_cj_spec ∗ *ts,* go_real *t,* go_traj_interp_spec ∗ *ti*) [inline]

go_traj_cj_interp() takes a go_traj_cj_spec and interpolates the d-v-a-j values for the given time t, storing the d-v-a-j values in ti.

run interpolation on each phase for each motion parameter, using

d = d0 + v0 t + 1/2 a0 t^2 + 1/6 j0 t^3 v = v0 + a0 t + 1/2 j0 t^2 a = a0 + j0 t j = j0

where d0, v0, a0, j0 are the initial values for each phase

6.1.3.170 go_result gomotion::go_traj_cj_scale (const go_traj_cj_spec ∗ *ts*, go_real *t*, go_traj_cj_spec ∗ *pts*) [inline]

go_traj_cj_scale() takes a time 't' for the desired time of the motion, and scales the times and motion params so that the total distance remains the same and everything else is in proportion

can't shrink shorter

can't shrink shorter

6.1.3.171 go_result gomotion::go_traj_cj_stop (const go_traj_cj_spec ∗ *ts*, go_real *t*, go_traj_cj_spec ∗ *pts*) [inline]

go_traj_cj_stop() takes a time 't' for the desired time to begin stopping, and recomputes the times so that the move will stop as soon as possible during subsequent interps.

incremental phase II distance

incremental phase III distance

incremental phase IV time

incremental phase IV distance

stopping in stage I

adjust stage I

null stage II, same as I

stage III

null stage IV, same as III

stage V

do earlier

so we can use it here

null stage VI, same as V

stage VII

stopping in stage II

stage I unchanged

adjust stage II

stage III

null stage IV, same as III

stage V

stage VI

stage VII

stopping in stage III

stages I, II and III unchanged

null stage IV

take off original stage IV for remaining stages

stopping in stage IV

stages I, II and III unchanged

adjusted stage IV

stopping in stage V, VI or VII– leave alone

incremental phase II distance

incremental phase III distance

incremental phase IV time

incremental phase IV distance

stopping in stage I

adjust stage I

null stage II, same as I

stage III

null stage IV, same as III

stage V

do earlier

so we can use it here

null stage VI, same as V

stage VII

stopping in stage II

stage I unchanged

adjust stage II

stage III

null stage IV, same as III

stage V

stage VI

stage VII

stopping in stage III

stages I, II and III unchanged

null stage IV

take off original stage IV for remaining stages

stopping in stage IV

stages I, II and III unchanged

adjusted stage IV

stopping in stage V, VI or VII– leave alone

6.1.3.172 go_result gomotion::go_tridiag_ql (go_real ∗ *d,* go_real ∗ *e,* go_integer *n,* go_real ∗∗ *z*)

This computes the eigenvalues and eigenvectors of the tridiagonalized matrix with diagonal *d* and off-diagonal *e*, using QL reduction with implicit shifts. *d*, *e* and *z* should have been generated by a prior call to go_tridiag_reduce. *d* will contain the eigenvalues, and *z* will contain the eigenvectors.

Calling example:

go_tridiag_reduce(matrix, 3, d, e); go_tridiag_ql(d, e, 3, matrix);

d will contain the eigenvalues of the original *matrix*, and the new *matrix* will contain the eigenvectors.

6.1.3.173 go_result gomotion::go_tridiag_reduce (go_real ** *a*, go_integer *n*, go_real * *d*, go_real * *e*)

This computes the Householder reduction to tridiagonal form of a real symmetric matrix *a*. *a* will contain the orthogonal matrix that effects the transformation. *d* will contain the diagonal elements, and *e* will contain the off-diagonal elements. This is used by go_tridiag_ql to find the eigenvalues and eigenvectors of a real symmetric matrix.

6.1.3.174 go_result gomotion::go_uxz_mat_convert (const go_uxz * *uxz*, go_mat * *mat*)

6.1.3.175 go_result gomotion::go_vector_cart_convert (const go_real * *v*, go_cart * *c*)

6.1.3.176 go_result gomotion::go_xyz_mat_convert (const go_xyz * *xyz*, go_mat * *m*)

6.1.3.177 go_result gomotion::go_xyz_quat_convert (const go_xyz *, go_quat *)

6.1.3.178 go_result gomotion::go_xyz_rpy_convert (const go_xyz *, go_rpy *)

6.1.3.179 go_result gomotion::go_xyz_rvec_convert (const go_xyz *, go_rvec *)

6.1.3.180 go_result gomotion::go_xyz_zyx_convert (const go_xyz *, go_zyx *)

6.1.3.181 go_result gomotion::go_xyz_zyz_convert (const go_xyz *, go_zyz *)

6.1.3.182 go_result gomotion::go_zyx_mat_convert (const go_zyx * *zyx*, go_mat * *m*)

6.1.3.183 go_result gomotion::go_zyx_quat_convert (const go_zyx * *zyx*, go_quat * *q*)

6.1.3.184 go_result gomotion::go_zyx_rpy_convert (const go_zyx * *zyx*, go_rpy * *rpy*)

6.1.3.185 go_result gomotion::go_zyx_rvec_convert (const go_zyx * *zyx*, go_rvec * *r*)

6.1.3.186 go_result gomotion::go_zyx_xyz_convert (const go_zyx *, go_xyz *)

6.1.3.187 go_result gomotion::go_zyx_zyz_convert (const go_zyx * *zyx*, go_zyz * *zyz*)

6.1.3.188 go_result gomotion::go_zyz_mat_convert (const go_zyz * *zyz*, go_mat * *m*)

6.1.3.189 go_result gomotion::go_zyz_quat_convert (const go_zyz * *zyz*, go_quat * *q*)

6.1.3.190 go_result gomotion::go_zyz_rpy_convert (const go_zyz * *zyz*, go_rpy * *rpy*)

6.1.3.191 go_result gomotion::go_zyz_rvec_convert (const go_zyz * *zyz*, go_rvec * *r*)

6.1.3.192 go_result gomotion::go_zyz_xyz_convert (const go_zyz *, go_xyz *)

6.1.3.193 go_result gomotion::go_zyz_zyx_convert (const go_zyz * *zyz*, go_zyx * *zyx*)

6.1.3.194 go_result gomotion::lubksb (go_real ∗∗ *a,* go_integer *n,* go_integer ∗ *indx,* go_real ∗ *b*)

6.1.3.195 go_result gomotion::ludcmp (go_real ∗∗ *a,* go_real ∗ *scratchrow,* go_integer *n,* go_integer ∗ *indx,* go_real ∗ *d*)

6.1.3.196 void gomotion::sincos (double *x,* double ∗ *sx,* double ∗ *cx*)

Chapter 7

Data Structure Documentation

7.1 gomotion::coeff Struct Reference

This structure holds the polynomial coefficients.

```
#include <gointerp.h>
```

Data Fields

- go_real a [COEFF_MAX]

7.1.1 Detailed Description

This structure holds the polynomial coefficients.

In the derivations below, coefficients a,b,c,d,... are used. Here, they correspond to the a[] array like this:

a[0] = 0th order coeff, e.g., 'd' for cubic a[1] = 1st order coeff, e.g., 'c' for cubic ...

7.1.2 Field Documentation

7.1.2.1 go_real gomotion::coeff::a[COEFF_MAX]

The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gointerp.h

7.2 gomotion::go_body Struct Reference

```
#include <gomath.h>
```

Data Fields

- go_real mass
- go_real inertia [3][3]

7.2.1 Detailed Description

Rigid body

7.2.2 Field Documentation

7.2.2.1 go_real gomotion::go_body::inertia[3][3]

The *inertia* matrix is the 3x3 matrix of moments of inertia with respect to the body's origin.

7.2.2.2 go_real gomotion::go_body::mass

total mass of the rigid body

The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.3 gomotion::go_cart Struct Reference

```
#include <gomath.h>
```

Data Fields

- go_real x
- go_real y
- go_real z

7.3.1 Detailed Description

A point or vector in Cartesian coordinates.

7.3.2 Field Documentation

7.3.2.1 go_real gomotion::go_cart::x

7.3.2.2 go_real gomotion::go_cart::y

7.3.2.3 go_real gomotion::go_cart::z

The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.4 gomotion::go_complex Struct Reference

```
#include <gomath.h>
```

Data Fields

- go_real re
- go_real im

7.4.1 Field Documentation

7.4.1.1 go_real gomotion::go_complex::im

7.4.1.2 go_real gomotion::go_complex::re

The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.5 gomotion::go_cubic Struct Reference

```
#include <gomath.h>
```

Data Fields

- go_real a
- go_real b
- go_real c

7.5.1 Field Documentation

7.5.1.1 go_real gomotion::go_cubic::a

7.5.1.2 go_real gomotion::go_cubic::b

7.5.1.3 go_real gomotion::go_cubic::c

The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.6 gomotion::go_cyl Struct Reference

```
#include <gomath.h>
```

Data Fields

- go_real theta
- go_real r
- go_real z

7.6.1 Detailed Description

A point or vector in cylindrical coordinates.

7.6.2 Field Documentation

7.6.2.1 go_real gomotion::go_cyl::r

7.6.2.2 go_real gomotion::go_cyl::theta

7.6.2.3 go_real gomotion::go_cyl::z

The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.7 gomotion::go_dh Struct Reference

```
#include <gomath.h>
```

Data Fields

- go_real a
- go_real alpha
- go_real d
- go_real theta

7.7.1 Detailed Description

These DH parameters follow the convention in John J. Craig, *Introduction to Robotics: Mechanics and Control*.

7.7.2 Field Documentation

7.7.2.1 go_real gomotion::go_dh::a

a[i-1]

7.7.2.2 go_real gomotion::go_dh::alpha

alpha[i-1]

7.7.2.3 go_real gomotion::go_dh::d

d[i]

7.7.2.4 go_real gomotion::go_dh::theta

theta[i]

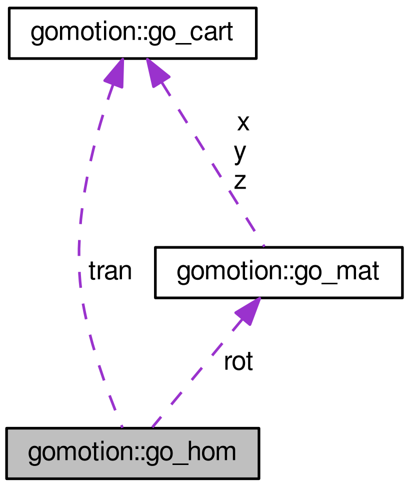
The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.8 gomotion::go_hom Struct Reference

```
#include <gomath.h>
```

Collaboration diagram for gomotion::go_hom:



Data Fields

- go_cart tran
- go_mat rot

7.8.1 Field Documentation

7.8.1.1 go_mat gomotion::go_hom::rot

7.8.1.2 go_cart gomotion::go_hom::tran

The documentation for this struct was generated from the following file:

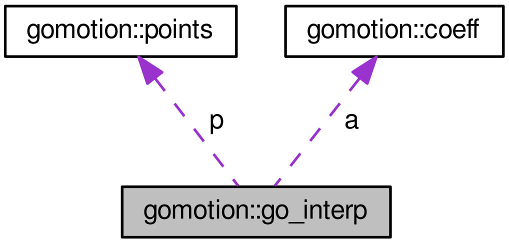
- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.9 gomotion::go_interp Class Reference

The interpolator structure.

`#include <gointerp.h>`

Collaboration diagram for gomotion::go_interp:



Public Types

- typedef go_result(∗ add_func)(go_real pos)
- typedef go_real(∗ eval_func)(const go_real t)

Public Member Functions

- go_result init ()
- go_result set_here (go_real here)
- go_result calc_coeff_constant (const points ∗p, coeff ∗a)
- go_result calc_coeff_linear (const points ∗p, coeff ∗a)
- go_result calc_coeff_cubic_bc (const points ∗p, coeff ∗a)
- go_result calc_coeff_cubic_pf (const points ∗p, coeff ∗a)
- go_result calc_coeff_quintic_bc (const points ∗p, coeff ∗a)
- go_result calc_coeff_quintic_pf (const points ∗p, coeff ∗a)
- go_result calc_coeff_bc (go_integer order, const points ∗p, coeff ∗a)
- go_result calc_coeff_pf (go_integer order, const points ∗p, coeff ∗a)
- go_real eval_constant (go_real t)
- go_real eval_linear (go_real t)
- go_real eval_cubic (go_real t)
- go_real eval_quintic (go_real t)
- go_result add_constant (go_real pos)
- go_result add_linear (go_real pos)
- go_result add_cubic_pv (go_real pos, go_real vel)
- go_result add_cubic_pdv (go_real pos)
- go_result add_cubic_pf (go_real pos)
- go_result add_quintic_pva (go_real pos, go_real vel, go_real acc)
- go_result add_quintic_pvda (go_real pos, go_real vel)

- go_result add_quintic_pdva (go_real pos)
- go_result add_quintic_pf (go_real pos)

Data Fields

- coeff a
- points p

7.9.1 Detailed Description

The interpolator structure.

For constant- and linear interpolation, exact-fit and boundary interpolation is the same, so we only have one type for these. Here we pass single points in succession, and interpolation is done at/between them.

For higher-order interpolation, we have two types, exact-fit and boundary. For exact-fit, we pass single points in succession, and interpolation is done in the middle interval. For boundary, we pass n-tuples of pos, vel, accel, etc. and interpolation is done between each tuple.

A variation on boundary interpolation is possible if the derivative values are not known but are estimated by differencing. The functions below suffixed _est are used for this.

7.9.2 Member Typedef Documentation

7.9.2.1 typedef **go_result**(∗ gomotion::go_interp::add_func)(**go_real** pos)

7.9.2.2 typedef **go_real**(∗ gomotion::go_interp::eval_func)(const **go_real** t)

7.9.3 Member Function Documentation

7.9.3.1 **go_result** gomotion::go_interp::add_constant (**go_real** *pos*)

7.9.3.2 **go_result** gomotion::go_interp::add_cubic_pdv (**go_real** *pos*)

7.9.3.3 **go_result** gomotion::go_interp::add_cubic_pf (**go_real** *pos*)

7.9.3.4 **go_result** gomotion::go_interp::add_cubic_pv (**go_real** *pos,* **go_real** *vel*)

7.9.3.5 **go_result** gomotion::go_interp::add_linear (**go_real** *pos*)

7.9.3.6 **go_result** gomotion::go_interp::add_quintic_pdva (**go_real** *pos*)

7.9.3.7 **go_result** gomotion::go_interp::add_quintic_pf (**go_real** *pos*)

7.9.3.8 **go_result** gomotion::go_interp::add_quintic_pva (**go_real** *pos,* **go_real** *vel,* **go_real** *acc*)

7.9.3.9 **go_result** gomotion::go_interp::add_quintic_pvda (**go_real** *pos,* **go_real** *vel*)

7.9.3.10 **go_result** gomotion::go_interp::calc_coeff_bc (**go_integer** *order,* const **points** ∗ *p,* **coeff** ∗ *a*)

7.9.3.11 **go_result** gomotion::go_interp::calc_coeff_constant (const **points** ∗ *p,* **coeff** ∗ *a*)

7.9.3.12 go_result gomotion::go_interp::calc_coeff_cubic_bc (const points ∗ *p*, coeff ∗ *a*)

7.9.3.13 go_result gomotion::go_interp::calc_coeff_cubic_pf (const points ∗ *p*, coeff ∗ *a*)

7.9.3.14 go_result gomotion::go_interp::calc_coeff_linear (const points ∗ *p*, coeff ∗ *a*)

7.9.3.15 go_result gomotion::go_interp::calc_coeff_pf (go_integer *order*, const points ∗ *p*, coeff ∗ *a*)

7.9.3.16 go_result gomotion::go_interp::calc_coeff_quintic_bc (const points ∗ *p*, coeff ∗ *a*)

7.9.3.17 go_result gomotion::go_interp::calc_coeff_quintic_pf (const points ∗ *p*, coeff ∗ *a*)

7.9.3.18 go_real gomotion::go_interp::eval_constant (go_real *t*)

7.9.3.19 go_real gomotion::go_interp::eval_cubic (go_real *t*)

7.9.3.20 go_real gomotion::go_interp::eval_linear (go_real *t*)

7.9.3.21 go_real gomotion::go_interp::eval_quintic (go_real *t*)

7.9.3.22 go_result gomotion::go_interp::init ( )

7.9.3.23 go_result gomotion::go_interp::set_here (go_real *here*)

7.9.4 Field Documentation

7.9.4.1 coeff gomotion::go_interp::a

7.9.4.2 points gomotion::go_interp::p

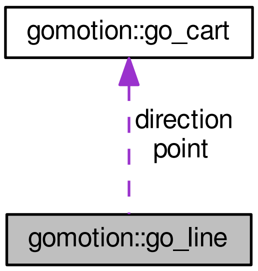
The documentation for this class was generated from the following files:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gointerp.h
- /usr/local/michalos/nistfanuc_ws/src/gomotion/src/gointerp.cpp

7.10 gomotion::go_line Struct Reference

```
#include <gomath.h>
```

Collaboration diagram for gomotion::go_line:



Data Fields

- go_cart point
- go_cart direction

7.10.1 Detailed Description

Lines are represented in point-direction form (point p, direction v) as (x - px)/vx = (y - py)/vy = (z - pz)vz

7.10.2 Field Documentation

7.10.2.1 go_cart gomotion::go_line::direction

7.10.2.2 go_cart gomotion::go_line::point

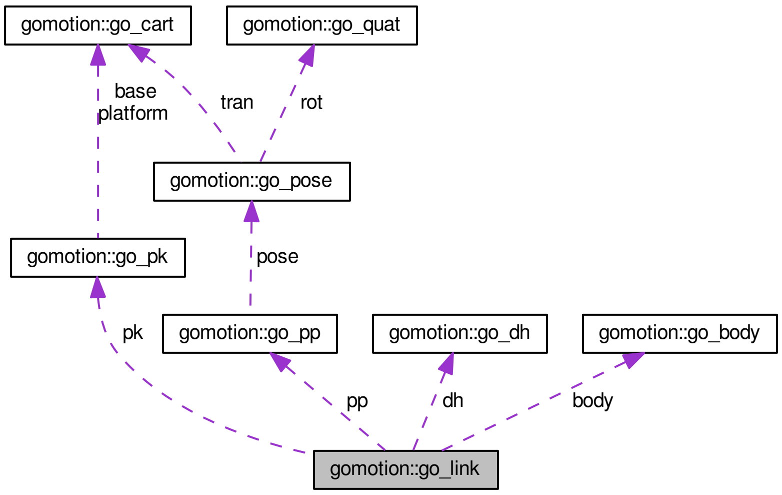
The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.11 gomotion::go_link Struct Reference

```
#include <gomath.h>
```

Collaboration diagram for gomotion::go_link:



Data Fields

- union {
  go_dh dh
  go_pk pk
  go_pp pp
  } u

- go_body body
- go_flag type
- go_flag quantity

7.11.1 Detailed Description

This is the generic link structure for PKM sliding/cable links and serial revolute/prismatic links.

7.11.2 Field Documentation

7.11.2.1 go_body gomotion::go_link::body

the link's rigid body parameters

7.11.2.2 go_dh gomotion::go_link::dh

if you have DH params and don't want to convert to PP

7.11.2.3 go_pk gomotion::go_link::pk

if you have a parallel machine, e.g., hexapod or robot crane

7.11.2.4 go_pp gomotion::go_link::pp

if you have a serial machine, e.g., an industrial robot

7.11.2.5 go_flag gomotion::go_link::quantity

one of GO_QUANTITY_LENGTH,ANGLE

7.11.2.6 go_flag gomotion::go_link::type

one of GO_LINK_DH,PK,PP

7.11.2.7 union { ... } gomotion::go_link::u

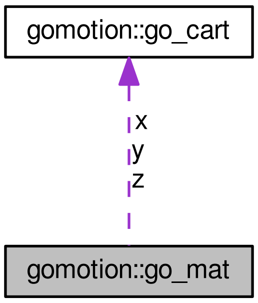
The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.12 gomotion::go_mat Struct Reference

```
#include <gomath.h>
```

Collaboration diagram for gomotion::go_mat:



Data Fields

- go_cart x

- go_cart y
- go_cart z

7.12.1 Detailed Description

A rotation matrix.

7.12.2 Field Documentation

7.12.2.1 go_cart gomotion::go_mat::x

X unit vector

7.12.2.2 go_cart gomotion::go_mat::y

Y unit vector

7.12.2.3 go_cart gomotion::go_mat::z

Z unit vector

The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.13 gomotion::go_matrix Struct Reference

```
#include <gomath.h>
```

Data Fields

- go_integer rows
- go_integer cols
- go_real ∗∗ el
- go_real ∗∗ elcpy
- go_real ∗ v
- go_integer ∗ index

7.13.1 Field Documentation

7.13.1.1 go_integer gomotion::go_matrix::cols

7.13.1.2 go_real∗∗ gomotion::go_matrix::el

7.13.1.3 go_real∗∗ gomotion::go_matrix::elcpy

7.13.1.4 go_integer∗ gomotion::go_matrix::index

7.13.1.5 go_integer gomotion::go_matrix::rows

7.13.1.6 go_real∗ gomotion::go_matrix::v

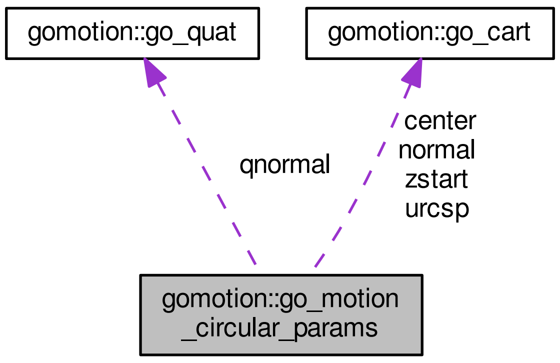
The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.14 gomotion::go_motion_circular_params Struct Reference

`#include <gomotion.h>`

Collaboration diagram for gomotion::go_motion_circular_params:



Data Fields

- go_cart center
- go_cart normal
- go_quat qnormal
- go_cart urcsp
- go_real rstart
- go_cart zstart
- go_real thtot
- go_real rtot
- go_real ztot
- go_real stotinv
- go_integer turns

7.14.1 Field Documentation

7.14.1.1 go_cart gomotion::go_motion_circular_params::center

The vector to the circle center.

7.14.1.2 go_cart gomotion::go_motion_circular_params::normal

The normal vector that defines the plane of the circle.

7.14.1.3 go_quat gomotion::go_motion_circular_params::qnormal

The normal vector expressed as a unit rotation.

7.14.1.4 go_real gomotion::go_motion_circular_params::rstart

The starting radius.

7.14.1.5 go_real gomotion::go_motion_circular_params::rtot

The signed displacement from start to end projected radii

7.14.1.6 go_real gomotion::go_motion_circular_params::stotinv

The inverse of total approximate arc length. If negative, no translation motion is taking place.

7.14.1.7 go_real gomotion::go_motion_circular_params::thtot

The signed total angular displacement around normal vector

7.14.1.8 go_integer gomotion::go_motion_circular_params::turns

The number of turns in the circle. 0 means partial CCW, -1 means partial CW, otherwise more turns are added in each direction.

7.14.1.9 go_cart gomotion::go_motion_circular_params::urcsp

The unit vector from center to start, projected onto the normal plane.

7.14.1.10 go_cart gomotion::go_motion_circular_params::zstart

The vector from the normal plane to the start.

7.14.1.11 go_real gomotion::go_motion_circular_params::ztot

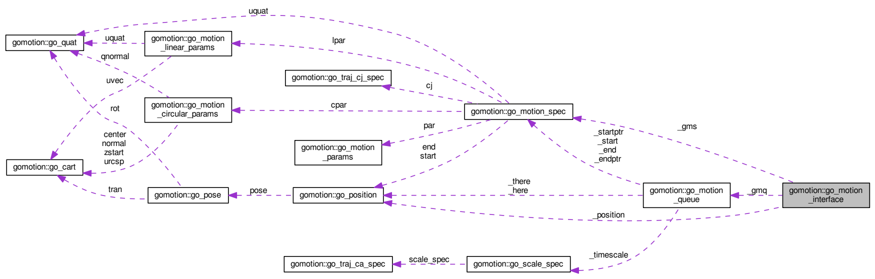
The signed displacement from start to end z off-normals

The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomotion.h

7.15 gomotion::go_motion_interface Struct Reference

Collaboration diagram for gomotion::go_motion_interface:


gomotion::go_quat
gomotion::go_motion_linear_params
gomotion::go_traj_cj_spec
gomotion::go_motion_circular_params
gomotion::go_motion_spec
gomotion::go_motion_params
gomotion::go_cart
gomotion::go_pose
gomotion::go_position
gomotion::go_motion_queue
gomotion::go_motion_interface
gomotion::go_traj_ca_spec
gomotion::go_scale_spec
uquat
qnormal
uvec
rot
center normal zstart urcsp
tran
lpar
cj
cpar
par
end start
_startptr _start _end _endptr
_gms
_there _here
_gmq
pose
_position
scale_spec
_timescale

Data Fields

- int _type
- double _deltat
- go_motion_spec _gms
- std::vector< go_motion_spec > _space
- go_motion_queue _gmq
- go_position _position
- size_t _queuesize

Static Public Attributes

- static size_t _id = 0

7.15.1 Field Documentation

7.15.1.1 double gomotion::go_motion_interface::_deltat

7.15.1.2 go_motion_queue gomotion::go_motion_interface::_gmq

7.15.1.3 go_motion_spec gomotion::go_motion_interface::_gms

7.15.1.4 size_t gomotion::go_motion_interface::_id = 0 [static]

7.15.1.5 go_position gomotion::go_motion_interface::_position

7.15.1.6 size_t gomotion::go_motion_interface::_queuesize

7.15.1.7 std::vector< go_motion_spec > gomotion::go_motion_interface::_space

7.15.1.8 int gomotion::go_motion_interface::_type

The documentation for this struct was generated from the following file:

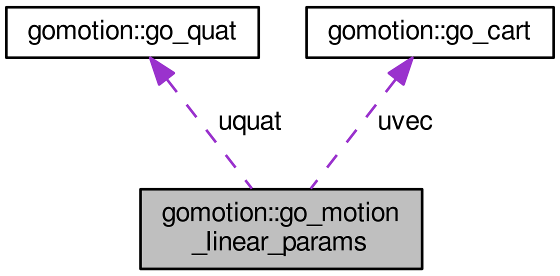
- /usr/local/michalos/nistfanuc_ws/src/gomotion/src/gomove.cpp

7.16 gomotion::go_motion_linear_params Struct Reference

In the following comments, LIN, CIR and ALL refer to linear moves, circular moves and both, respectively.

`#include <gomotion.h>`

Collaboration diagram for gomotion::go_motion_linear_params:



Data Fields

- go_cart uvec
- go_quat uquat

7.16.1 Detailed Description

In the following comments, LIN, CIR and ALL refer to linear moves, circular moves and both, respectively.

If they are not in parens, e.g., ALL:, you need to provide them for that type of motion. If they are in parens, e.g., (CIR), they are computed for you.

7.16.2 Field Documentation

7.16.2.1 go_quat gomotion::go_motion_linear_params::uquat

7.16.2.2 go_cart gomotion::go_motion_linear_params::uvec

The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomotion.h

7.17 gomotion::go_motion_params Struct Reference

```
#include <gomotion.h>
```

Data Fields

- go_real vel

  max vel for each motion
- go_real acc

  max accel for each motion
- go_real jerk

  max jerk for each motion

7.17.1 Field Documentation

7.17.1.1 go_real gomotion::go_motion_params::acc

max accel for each motion

7.17.1.2 go_real gomotion::go_motion_params::jerk

max jerk for each motion

7.17.1.3 go_real gomotion::go_motion_params::vel

max vel for each motion

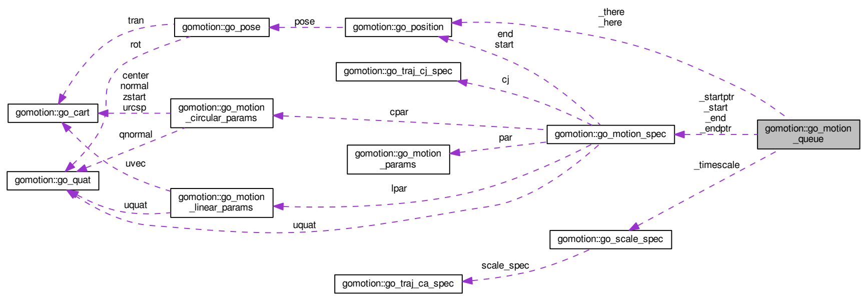
The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomotion.h

7.18 gomotion::go_motion_queue Struct Reference

```
#include <gomotion.h>
```

Collaboration diagram for gomotion::go_motion_queue:



Public Member Functions

- go_result init (go_motion_spec ∗space, go_integer size, go_real deltat)
- go_result reset ()
- go_result set_type (go_flag type)
- go_flag get_type ()
- go_result set_joint_number (go_integer joints)
- go_integer get_joint_number ()
- go_result set_here (const go_position ∗here)
- go_result set_cycle_time (go_real deltat)
- go_result set_scale (go_real scale, go_real scale_v, go_real scale_a)
- go_result append (const go_motion_spec ∗motion)
- go_result number (go_integer ∗number)
- go_result size (go_integer ∗size)
- go_result head (go_motion_spec ∗motion)
- go_result here (go_position ∗position)
- go_result there (go_position ∗position)
- go_result interp (go_position ∗position)
- go_result stop (go_motion_queue ∗queue)
- go_result set_id (go_integer id)
- go_integer last_id ()
- go_flag is_empty ()
- go_result erase ()
- go_result drop_pending ()
- go_result stop ()

Data Fields

- go_flag _type

  go_MOTION_JOINT for joint, otherwise world
- go_position _here

  initial starting point
- go_position _there

  where the end is
- go_motion_spec ∗ _startptr

ptr to original start

- go_motion_spec ∗ _endptr

  the original end
- go_motion_spec ∗ _start

  ptr to first entry of the queue
- go_motion_spec ∗ _end

  ptr to last (empty) entry
- go_integer _size

  size of whole queue
- go_integer _joint_num

  number of joints to be interpolated
- go_integer _number

  number of motions on queue
- go_integer _last_id

  id of last motion appended
- go_real _deltat

  cycle time
- go_real _time

  time into the current spec
- go_scale_spec _timescale

  walked-in time scale factor

Protected Member Functions

- go_result append_joint (const go_motion_spec ∗motion)
- go_result append_ujoint (const go_motion_spec ∗motion)
- go_result append_world (const go_motion_spec ∗motion)
- go_result interp_joint (go_real ∗joint)
- go_result interp_world (go_pose ∗pose)
- go_result interp_world (go_motion_spec ∗motion, go_real time, go_pose ∗pose)

7.18.1 Member Function Documentation

7.18.1.1 go_result gomotion::go_motion_queue::append (const go_motion_spec ∗ *motion*)

7.18.1.2 go_result gomotion::go_motion_queue::append_joint (const go_motion_spec ∗ *motion*) [protected]

7.18.1.3 go_result gomotion::go_motion_queue::append_ujoint (const go_motion_spec ∗ *motion*) [protected]

7.18.1.4 go_result gomotion::go_motion_queue::append_world (const go_motion_spec ∗ *motion*) [protected]

7.18.1.5 go_result gomotion::go_motion_queue::drop_pending ( )

7.18.1.6 go_result gomotion::go_motion_queue::erase ( )

7.18.1.7 go_integer gomotion::go_motion_queue::get_joint_number ( )

7.18.1.8 go_flag gomotion::go_motion_queue::get_type ( )

7.18.1.9 **go_result** gomotion::go_motion_queue::head (**go_motion_spec** ∗ *motion*)

7.18.1.10 **go_result** gomotion::go_motion_queue::here (**go_position** ∗ *position*)

7.18.1.11 **go_result** gomotion::go_motion_queue::init (**go_motion_spec** ∗ *space,* **go_integer** *size,* **go_real** *deltat*)

7.18.1.12 **go_result** gomotion::go_motion_queue::interp (**go_position** ∗ *position*)

7.18.1.13 **go_result** gomotion::go_motion_queue::interp_joint (**go_real** ∗ *joint*) [protected]

7.18.1.14 **go_result** gomotion::go_motion_queue::interp_world (**go_pose** ∗ *pose*) [protected]

7.18.1.15 **go_result** gomotion::go_motion_queue::interp_world (**go_motion_spec** ∗ *motion,* **go_real** *time,* **go_pose** ∗ *pose*) [protected]

7.18.1.16 **go_flag** gomotion::go_motion_queue::is_empty ( )

7.18.1.17 **go_integer** gomotion::go_motion_queue::last_id ( )

7.18.1.18 **go_result** gomotion::go_motion_queue::number (**go_integer** ∗ *number*)

7.18.1.19 **go_result** gomotion::go_motion_queue::reset ( )

7.18.1.20 **go_result** gomotion::go_motion_queue::set_cycle_time (**go_real** *deltat*)

7.18.1.21 **go_result** gomotion::go_motion_queue::set_here (const **go_position** ∗ *here*)

7.18.1.22 **go_result** gomotion::go_motion_queue::set_id (**go_integer** *id*)

7.18.1.23 **go_result** gomotion::go_motion_queue::set_joint_number (**go_integer** *joints*)

7.18.1.24 **go_result** gomotion::go_motion_queue::set_scale (**go_real** *scale,* **go_real** *scale_v,* **go_real** *scale_a*)

7.18.1.25 **go_result** gomotion::go_motion_queue::set_type (**go_flag** *type*)

7.18.1.26 **go_result** gomotion::go_motion_queue::size (**go_integer** ∗ *size*)

7.18.1.27 **go_result** gomotion::go_motion_queue::stop (**go_motion_queue** ∗ *queue*)

7.18.1.28 **go_result** gomotion::go_motion_queue::stop ( )

7.18.1.29 **go_result** gomotion::go_motion_queue::there (**go_position** ∗ *position*)

7.18.2 Field Documentation

7.18.2.1 **go_real** gomotion::go_motion_queue::_deltat

cycle time

7.18.2.2 **go_motion_spec**∗ gomotion::go_motion_queue::_end

ptr to last (empty) entry

7.18.2.3 go_motion_spec∗ gomotion::go_motion_queue::_endptr

the original end

7.18.2.4 go_position gomotion::go_motion_queue::_here

initial starting point

7.18.2.5 go_integer gomotion::go_motion_queue::_joint_num

number of joints to be interpolated

7.18.2.6 go_integer gomotion::go_motion_queue::_last_id

id of last motion appended

7.18.2.7 go_integer gomotion::go_motion_queue::_number

number of motions on queue

7.18.2.8 go_integer gomotion::go_motion_queue::_size

size of whole queue

7.18.2.9 go_motion_spec∗ gomotion::go_motion_queue::_start

ptr to first entry of the queue

7.18.2.10 go_motion_spec∗ gomotion::go_motion_queue::_startptr

ptr to original start

7.18.2.11 go_position gomotion::go_motion_queue::_there

where the end is

7.18.2.12 go_real gomotion::go_motion_queue::_time

time into the current spec

7.18.2.13 go_scale_spec gomotion::go_motion_queue::_timescale

walked-in time scale factor

7.18.2.14 go_flag gomotion::go_motion_queue::_type

go_MOTION_JOINT for joint, otherwise world

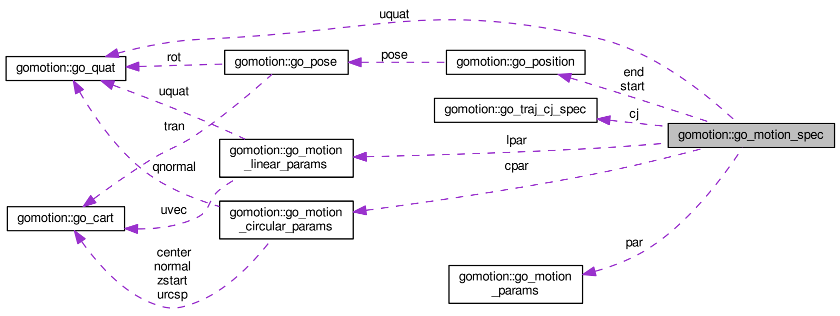
The documentation for this struct was generated from the following files:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomotion.h
- /usr/local/michalos/nistfanuc_ws/src/gomotion/src/gomotion.cpp

7.19 gomotion::go_motion_spec Struct Reference

```
#include <gomotion.h>
```

Collaboration diagram for gomotion::go_motion_spec:



Public Member Functions

- go_result init ()
- go_result set_type (go_flag type)
- go_flag get_type ()
- go_result set_id (go_integer id)
- go_integer get_id ()
- go_result set_jpar (go_integer i, go_real vel, go_real acc, go_real jerk)
- go_result set_tpar (go_real vel, go_real acc, go_real jerk)
- go_result set_rpar (go_real vel, go_real acc, go_real jerk)
- go_result set_cpar (go_cart ∗center, go_cart ∗normal, go_integer turns)
- go_result set_time (go_real time)
- go_result set_end_position (go_position ∗end)
- go_result set_end_pose (go_pose ∗end)

Data Fields

- go_flag type

  ALL: GO_MOTION_JOINT,LINEAR,CIRCULAR.
- go_integer id

  ALL: id echoed as current move.

- go_real totalt

    (ALL) total planned time for the motion
- go_position start

    (ALL) start pose wrt world; prev end
- go_position end

    ALL: target position, joints or pose.
- go_quat uquat

    (ALL) unit rotation from start to end
- go_motion_params par [GO_MOTION_JOINT_NUM]
- union {

    go_motion_linear_params lpar
        (LIN) linear params
    go_motion_circular_params cpar
        CIR: some circular params.

    } u
- go_traj_cj_spec cj [GO_MOTION_JOINT_NUM]

7.19.1 Member Function Documentation

7.19.1.1 go_integer gomotion::go_motion_spec::get_id ( )

7.19.1.2 go_flag gomotion::go_motion_spec::get_type ( )

7.19.1.3 go_result gomotion::go_motion_spec::init ( )

7.19.1.4 go_result gomotion::go_motion_spec::set_cpar (go_cart ∗ *center*, go_cart ∗ *normal*, go_integer *turns*)

7.19.1.5 go_result gomotion::go_motion_spec::set_end_pose (go_pose ∗ *end*)

7.19.1.6 go_result gomotion::go_motion_spec::set_end_position (go_position ∗ *end*)

7.19.1.7 go_result gomotion::go_motion_spec::set_id (go_integer *id*)

7.19.1.8 go_result gomotion::go_motion_spec::set_jpar (go_integer *i*, go_real *vel*, go_real *acc*, go_real *jerk*)

7.19.1.9 go_result gomotion::go_motion_spec::set_rpar (go_real *vel*, go_real *acc*, go_real *jerk*)

7.19.1.10 go_result gomotion::go_motion_spec::set_time (go_real *time*)

7.19.1.11 go_result gomotion::go_motion_spec::set_tpar (go_real *vel*, go_real *acc*, go_real *jerk*)

7.19.1.12 go_result gomotion::go_motion_spec::set_type (go_flag *type*)

7.19.2 Field Documentation

7.19.2.1 go_traj_cj_spec gomotion::go_motion_spec::cj[GO_MOTION_JOINT_NUM]

7.19.2.2 go_motion_circular_params gomotion::go_motion_spec::cpar

CIR: some circular params.

7.19.2.3 go_position gomotion::go_motion_spec::end

ALL: target position, joints or pose.

7.19.2.4 go_integer gomotion::go_motion_spec::id

ALL: id echoed as current move.

7.19.2.5 go_motion_linear_params gomotion::go_motion_spec::lpar

(LIN) linear params

7.19.2.6 go_motion_params gomotion::go_motion_spec::par[GO_MOTION_JOINT_NUM]

7.19.2.7 go_position gomotion::go_motion_spec::start

(ALL) start pose wrt world; prev end

7.19.2.8 go_real gomotion::go_motion_spec::totalt

(ALL) total planned time for the motion

7.19.2.9 go_flag gomotion::go_motion_spec::type

ALL: GO_MOTION_JOINT,LINEAR,CIRCULAR.

7.19.2.10 union { ... } gomotion::go_motion_spec::u

7.19.2.11 go_quat gomotion::go_motion_spec::uquat

(ALL) unit rotation from start to end

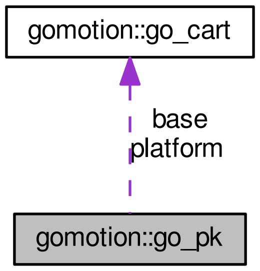
The documentation for this struct was generated from the following files:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomotion.h
- /usr/local/michalos/nistfanuc_ws/src/gomotion/src/gomotion.cpp

7.20 gomotion::go_pk Struct Reference

```
#include <gomath.h>
```

Collaboration diagram for gomotion::go_pk:



Data Fields

- go_cart base
- go_cart platform
- go_real d

7.20.1 Detailed Description

PK parameters are used for parallel kinematic mechanisms, and represent the Cartesian positions of the ends of the link in the stationary base frame and the moving platform frame. Currently this only supports prismatic links.

7.20.2 Field Documentation

7.20.2.1 go_cart gomotion::go_pk::base

position of fixed end in base frame

7.20.2.2 go_real gomotion::go_pk::d

the length of the link

7.20.2.3 go_cart gomotion::go_pk::platform

position of moving end in platform frame

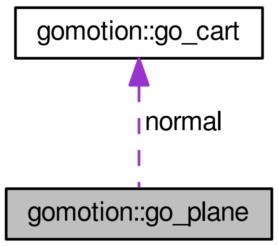
The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.21 gomotion::go_plane Struct Reference

```
#include <gomath.h>
```

Collaboration diagram for gomotion::go_plane:



Data Fields

- go_cart normal
- go_real d

7.21.1 Detailed Description

Given a plane as Ax + By + Cz + D = 0, the normal vector *normal* is the Cartesian vector (A,B,C), and the number *d* is the value D.

Planes have a handedness, given by the direction of the normal vector, so two planes that appear coincident may be different by the direction of their anti-parallel normal vectors.

7.21.2 Field Documentation

7.21.2.1 go_real gomotion::go_plane::d

7.21.2.2 go_cart gomotion::go_plane::normal

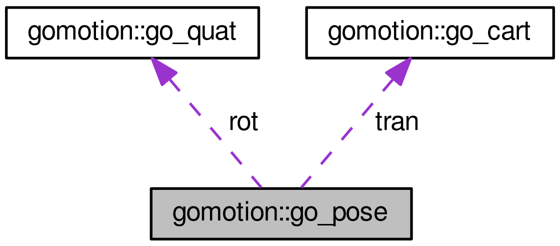
The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.22 gomotion::go_pose Struct Reference

```
#include <gomath.h>
```

Collaboration diagram for gomotion::go_pose:



Data Fields

- go_cart tran
- go_quat rot

7.22.1 Detailed Description

A *go_pose* represents the Cartesian position vector and quaternion orientation of a frame.

7.22.2 Field Documentation

7.22.2.1 go_quat gomotion::go_pose::rot

7.22.2.2 go_cart gomotion::go_pose::tran

The documentation for this struct was generated from the following file:

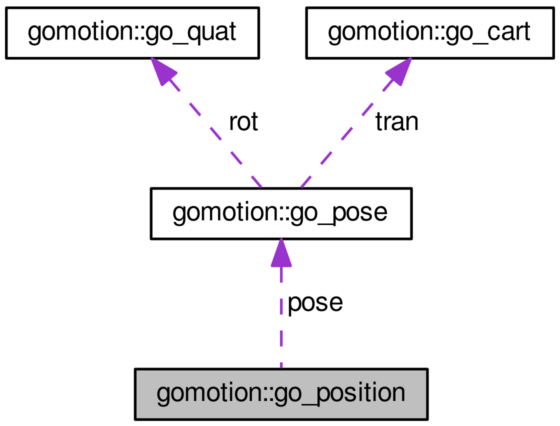
- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.23 gomotion::go_position Struct Reference

Depending upon whether you are doing joint interpolation or world coordinate interpolation (as specified by your call to go_motion_queue_set_type()), fill in joint[] or pose accordingly.

```
#include <gomotion.h>
```

Collaboration diagram for gomotion::go_position:



Public Member Functions

- void zero_joints ()
- void zero_pose ()

Data Fields

- union {
  go_real joint [GO_MOTION_JOINT_NUM]
  go_pose pose
  } u

7.23.1 Detailed Description

Depending upon whether you are doing joint interpolation or world coordinate interpolation (as specified by your call to go_motion_queue_set_type()), fill in joint[] or pose accordingly.

7.23.2 Member Function Documentation

7.23.2.1 void gomotion::go_position::zero_joints ( )

7.23.2.2 void gomotion::go_position::zero_pose ( )

7.23.3 Field Documentation

7.23.3.1 go_real gomotion::go_position::joint[GO_MOTION_JOINT_NUM]

7.23.3.2 go_pose gomotion::go_position::pose

7.23.3.3 union { ... } gomotion::go_position::u

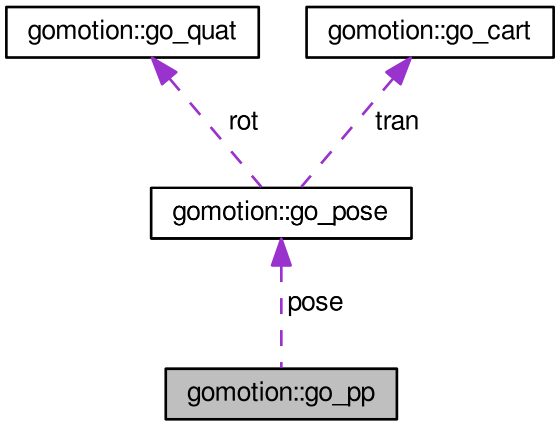
The documentation for this struct was generated from the following files:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomotion.h
- /usr/local/michalos/nistfanuc_ws/src/gomotion/src/gomotion.cpp

7.24 gomotion::go_pp Struct Reference

```
#include <gomath.h>
```

Collaboration diagram for gomotion::go_pp:



Data Fields

- go_pose pose

7.24.1 Detailed Description

PP parameters represent the pose of the link with respect to the previous link. Revolute joints rotate about the Z axis, prismatic joints slide along the Z axis.

7.24.2 Field Documentation

7.24.2.1 go_pose gomotion::go_pp::pose

the pose of the link wrt to the previous link

The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.25 gomotion::go_quadratic Struct Reference

```
#include <gomath.h>
```

Data Fields

- go_real a
- go_real b

7.25.1 Field Documentation

7.25.1.1 go_real gomotion::go_quadratic::a

7.25.1.2 go_real gomotion::go_quadratic::b

The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.26 gomotion::go_quartic Struct Reference

```
#include <gomath.h>
```

Data Fields

- go_real a
- go_real b
- go_real c
- go_real d

7.26.1 Field Documentation

7.26.1.1 go_real gomotion::go_quartic::a

7.26.1.2 go_real gomotion::go_quartic::b

7.26.1.3 go_real gomotion::go_quartic::c

7.26.1.4 go_real gomotion::go_quartic::d

The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.27 gomotion::go_quat Struct Reference

```
#include <gomath.h>
```

Data Fields

- go_real s
- go_real x
- go_real y
- go_real z

7.27.1 Detailed Description

A quaternion. *s* is the cosine of the half angle of rotation, and the *xyz* elements comprise the vector that points in the direction of positive rotation and whose magnitude is the sine of the half angle of rotation.

7.27.2 Field Documentation

7.27.2.1 go_real gomotion::go_quat::s

7.27.2.2 go_real gomotion::go_quat::x

7.27.2.3 go_real gomotion::go_quat::y

7.27.2.4 go_real gomotion::go_quat::z

The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.28 gomotion::go_rpy Struct Reference

```
#include <gomath.h>
```

Data Fields

- go_real r
- go_real p
- go_real y

7.28.1 Detailed Description

Roll-pitch-yaw angles. *r* is the amount of the first rotation (roll) around the X axis. *p* is the amount of the second rotation (pitch) around the original Y axis. *y* is the amount of the third rotation (yaw) around the original Z axis.

7.28.2 Field Documentation

7.28.2.1 go_real gomotion::go_rpy::p

7.28.2.2 go_real gomotion::go_rpy::r

7.28.2.3 go_real gomotion::go_rpy::y

The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.29 gomotion::go_rvec Struct Reference

```
#include <gomath.h>
```

Data Fields

- go_real x
- go_real y
- go_real z

7.29.1 Detailed Description

A rotation vector, whose direction points along the axis of positive rotation, and whose magnitude is the amount of rotation around this axis, in radians.

7.29.2 Field Documentation

7.29.2.1 go_real gomotion::go_rvec::x

7.29.2.2 go_real gomotion::go_rvec::y

7.29.2.3 go_real gomotion::go_rvec::z

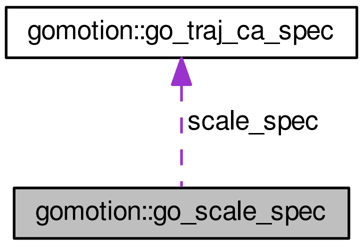
The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.30 gomotion::go_scale_spec Struct Reference

```
#include <gomotion.h>
```

Collaboration diagram for gomotion::go_scale_spec:



Public Member Functions

- go_result init (go_real scale)
- go_result set (go_real scale, go_real scale_v, go_real scale_a)
- go_result eval (go_real deltat, go_real ∗scale)

Data Fields

- go_traj_ca_spec scale_spec
- go_flag scaling

  non-zero means we're scaling time
- go_flag scale_dir

  non-zero means add scale to scale_b
- go_flag scale_isneg

  non-zero means negative scale
- go_real scale_b

  original base scale factor
- go_real scale

  current scale factor
- go_real scale_next

  pending scale factor
- go_real scale_v_next

  pending d(scale)/dt
- go_real scale_a_next

  pending d^2(scale)/dt^2
- go_real scale_t

  time into scaling

7.30.1 Member Function Documentation

7.30.1.1 go_result gomotion::go_scale_spec::eval (go_real *deltat,* go_real ∗ *scale*)

7.30.1.2 go_result gomotion::go_scale_spec::init (go_real *scale*)

7.30.1.3 go_result gomotion::go_scale_spec::set (go_real *scale,* go_real *scale_v,* go_real *scale_a*)

7.30.2 Field Documentation

7.30.2.1 go_real gomotion::go_scale_spec::scale

current scale factor

7.30.2.2 go_real gomotion::go_scale_spec::scale_a_next

pending d^2(scale)/dt^2

7.30.2.3 go_real gomotion::go_scale_spec::scale_b

original base scale factor

7.30.2.4 go_flag gomotion::go_scale_spec::scale_dir

non-zero means add scale to scale_b

7.30.2.5 go_flag gomotion::go_scale_spec::scale_isneg

non-zero means negative scale

7.30.2.6 go_real gomotion::go_scale_spec::scale_next

pending scale factor

7.30.2.7 go_traj_ca_spec gomotion::go_scale_spec::scale_spec

7.30.2.8 go_real gomotion::go_scale_spec::scale_t

time into scaling

7.30.2.9 go_real gomotion::go_scale_spec::scale_v_next

pending d(scale)/dt

7.30.2.10 go_flag gomotion::go_scale_spec::scaling

non-zero means we're scaling time

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

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomotion.h
- /usr/local/michalos/nistfanuc_ws/src/gomotion/src/gomotion.cpp

7.31 gomotion::go_sph Struct Reference

```
#include <gomath.h>
```

Data Fields

- go_real theta
- go_real phi
- go_real r

7.31.1 Detailed Description

A point or vector in spherical coordinates, with *phi* as the angle down from the zenith, not up from the XY plane.

7.31.2 Field Documentation

7.31.2.1 go_real gomotion::go_sph::phi

7.31.2.2 go_real gomotion::go_sph::r

7.31.2.3 go_real gomotion::go_sph::theta

The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.32 gomotion::go_traj_ca_spec Struct Reference

```
#include <gotraj.h>
```

Data Fields

- go_real at0

    accel for Phase I and III
- go_real t1

    cumulative time at end of Phase I
- go_real dt1

cumulative distance at end of Phase I
- go_real vt1

  speed at end of Phase I/in Phase II
- go_real t2

  cumulative time at end of Phase II
- go_real dt2

  cumulative distance at end of Phase II
- go_real tend

  total time for motion
- go_real dtend

  total distance for motion
- go_real invd

  inverse of total distance

7.32.1 Field Documentation

7.32.1.1 go_real gomotion::go_traj_ca_spec::at0

accel for Phase I and III

7.32.1.2 go_real gomotion::go_traj_ca_spec::dt1

cumulative distance at end of Phase I

7.32.1.3 go_real gomotion::go_traj_ca_spec::dt2

cumulative distance at end of Phase II

7.32.1.4 go_real gomotion::go_traj_ca_spec::dtend

total distance for motion

7.32.1.5 go_real gomotion::go_traj_ca_spec::invd

inverse of total distance

7.32.1.6 go_real gomotion::go_traj_ca_spec::t1

cumulative time at end of Phase I

7.32.1.7 go_real gomotion::go_traj_ca_spec::t2

cumulative time at end of Phase II

7.32.1.8 go_real gomotion::go_traj_ca_spec::tend

total time for motion

7.32.1.9 go_real gomotion::go_traj_ca_spec::vt1

speed at end of Phase I/in Phase II

The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gotraj.h

7.33 gomotion::go_traj_cj_spec Struct Reference

```
#include <gotraj.h>
```

Data Fields

- go_real jt0

  jerk in Phases I, III, V, VII
- go_real t1

  cumulative time at end of Phase I
- go_real dt1

  cumulative distance at end of Phase I
- go_real vt1

  speed at end of Phase I
- go_real at1

  accel at end of Phase I
- go_real t2

  cumulative time at end of Phase II
- go_real dt2

  cumulative distance at end of Phase II
- go_real vt2

  speed at end of Phase II
- go_real t3

  cumulative time at end of Phase III
- go_real dt3

  cumulative distance at end of Phase III
- go_real vt3

  speed at end of Phase III/in Phase IV
- go_real t4

  cumulative time at end of Phase IV
- go_real dt4

  cumulative distance at end of Phase IV
- go_real t5

  cumulative time at end of Phase V
- go_real dt5

cumulative distance at end of Phase V
- go_real t6

  cumulative time at end of Phase VI
- go_real dt6

  cumulative distance at end of Phase VI
- go_real tend

  total time for motion
- go_real dtend

  total distance for motion
- go_real invd

  inverse of total distance

7.33.1 Field Documentation

7.33.1.1 go_real gomotion::go_traj_cj_spec::at1

accel at end of Phase I

7.33.1.2 go_real gomotion::go_traj_cj_spec::dt1

cumulative distance at end of Phase I

7.33.1.3 go_real gomotion::go_traj_cj_spec::dt2

cumulative distance at end of Phase II

7.33.1.4 go_real gomotion::go_traj_cj_spec::dt3

cumulative distance at end of Phase III

7.33.1.5 go_real gomotion::go_traj_cj_spec::dt4

cumulative distance at end of Phase IV

7.33.1.6 go_real gomotion::go_traj_cj_spec::dt5

cumulative distance at end of Phase V

7.33.1.7 go_real gomotion::go_traj_cj_spec::dt6

cumulative distance at end of Phase VI

7.33.1.8 go_real gomotion::go_traj_cj_spec::dtend

total distance for motion

7.33.1.9 go_real gomotion::go_traj_cj_spec::invd

inverse of total distance

7.33.1.10 go_real gomotion::go_traj_cj_spec::jt0

jerk in Phases I, III, V, VII

7.33.1.11 go_real gomotion::go_traj_cj_spec::t1

cumulative time at end of Phase I

7.33.1.12 go_real gomotion::go_traj_cj_spec::t2

cumulative time at end of Phase II

7.33.1.13 go_real gomotion::go_traj_cj_spec::t3

cumulative time at end of Phase III

7.33.1.14 go_real gomotion::go_traj_cj_spec::t4

cumulative time at end of Phase IV

7.33.1.15 go_real gomotion::go_traj_cj_spec::t5

cumulative time at end of Phase V

7.33.1.16 go_real gomotion::go_traj_cj_spec::t6

cumulative time at end of Phase VI

7.33.1.17 go_real gomotion::go_traj_cj_spec::tend

total time for motion

7.33.1.18 go_real gomotion::go_traj_cj_spec::vt1

speed at end of Phase I

7.33.1.19 go_real gomotion::go_traj_cj_spec::vt2

speed at end of Phase II

7.33.1.20 go_real gomotion::go_traj_cj_spec::vt3

speed at end of Phase III/in Phase IV

The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gotraj.h

7.34 gomotion::go_traj_interp_spec Struct Reference

```
#include <gotraj.h>
```

Data Fields

- go_real s
- go_real d
- go_real v
- go_real a
- go_real j

7.34.1 Field Documentation

7.34.1.1 go_real gomotion::go_traj_interp_spec::a

7.34.1.2 go_real gomotion::go_traj_interp_spec::d

7.34.1.3 go_real gomotion::go_traj_interp_spec::j

7.34.1.4 go_real gomotion::go_traj_interp_spec::s

7.34.1.5 go_real gomotion::go_traj_interp_spec::v

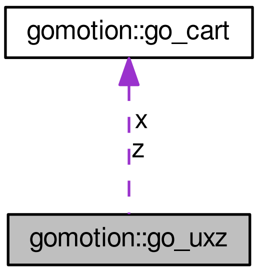
The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gotraj.h

7.35 gomotion::go_uxz Struct Reference

```
#include <gomath.h>
```

Collaboration diagram for gomotion::go_uxz:



Data Fields

- go_cart x
- go_cart z

7.35.1 Detailed Description

X-Z vector format. *x* is a unit vector in the X direction, and *z* is a unit vector in the Z direction.

7.35.2 Field Documentation

7.35.2.1 go_cart gomotion::go_uxz::x

7.35.2.2 go_cart gomotion::go_uxz::z

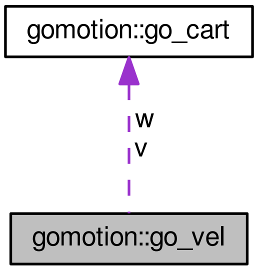
The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.36 gomotion::go_vel Struct Reference

```
#include <gomath.h>
```

Collaboration diagram for gomotion::go_vel:



Data Fields

- go_cart v
- go_cart w

7.36.1 Detailed Description

A *go_vel* represents the linear- and angular velocity vectors of a frame. *v* is the Cartesian linear velocity vector. *w* is the Cartesian angular velocity vector, the instantaneous vector about which the frame is rotating.

7.36.2 Field Documentation

7.36.2.1 go_cart gomotion::go_vel::v

7.36.2.2 go_cart gomotion::go_vel::w

The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.37 gomotion::go_xyz Struct Reference

```
#include <gomath.h>
```

Data Fields

- go_real x
- go_real y
- go_real z

7.37.1 Detailed Description

XYZ Euler angles. *x* is the amount of the first rotation around the X axis. *y* is the amount of the second rotation around the new *Y* axis. *z* is the amount of the third rotation around the new *Z* axis.

7.37.2 Field Documentation

7.37.2.1 go_real gomotion::go_xyz::x

7.37.2.2 go_real gomotion::go_xyz::y

7.37.2.3 go_real gomotion::go_xyz::z

The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.38 gomotion::go_zyx Struct Reference

```
#include <gomath.h>
```

Data Fields

- go_real z
- go_real y
- go_real x

7.38.1 Detailed Description

ZYX Euler angles. *z* is the amount of the first rotation around the Z axis. *y* is the amount of the second rotation around the new *Y* axis. *x* is the amount of the third rotation around the new *X* axis.

7.38.2 Field Documentation

7.38.2.1 go_real gomotion::go_zyx::x

7.38.2.2 go_real gomotion::go_zyx::y

7.38.2.3 go_real gomotion::go_zyx::z

The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.39 gomotion::go_zyz Struct Reference

```
#include <gomath.h>
```

Data Fields

- go_real z
- go_real y
- go_real zp

7.39.1 Detailed Description

ZYZ Euler angles. *z* is the amount of the first rotation around the Z axis. *y* is the amount of the second rotation around the new *Y* axis. *zp* is the amount of the third rotation around the new *Z* axis.

7.39.2 Field Documentation

7.39.2.1 go_real gomotion::go_zyz::y

7.39.2.2 go_real gomotion::go_zyz::z

7.39.2.3 go_real gomotion::go_zyz::zp

The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h

7.40 gomotion::GoMotion Class Reference

```
#include <gomove.h>
```

Protected Attributes

- boost::shared_ptr
  < go_motion_interface > pgm

7.40.1 Field Documentation

7.40.1.1 boost::shared_ptr<go_motion_interface> gomotion::GoMotion::pgm [protected]

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

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomove.h
- /usr/local/michalos/nistfanuc_ws/src/gomotion/src/gomove.cpp

7.41 gomotion::GoMotionParams Struct Reference

```
#include <gomove.h>
```

Data Fields

- double vel
- double acc
- double jerk

7.41.1 Field Documentation

7.41.1.1 double gomotion::GoMotionParams::acc

7.41.1.2 double gomotion::GoMotionParams::jerk

7.41.1.3 double gomotion::GoMotionParams::vel

The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomove.h

7.42 gomotion::points Struct Reference

This structure holds the points to be interpolated.

```
#include <gointerp.h>
```

Data Fields

- go_real p [COEFF_MAX]

7.42.1 Detailed Description

This structure holds the points to be interpolated.

See notes below for how to fill the p[] array for the particular type of interpolation.

7.42.2 Field Documentation

7.42.2.1 go_real gomotion::points::p[COEFF_MAX]

The documentation for this struct was generated from the following file:

- /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gointerp.h

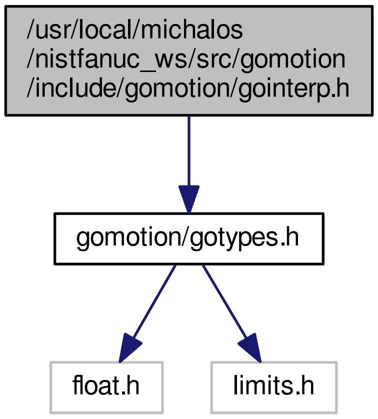
Chapter 8

File Documentation

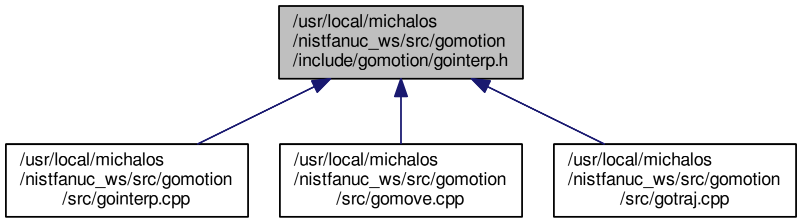
8.1 /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gointerp.h File Reference

```
#include "gomotion/gotypes.h"
```

Include dependency graph for gointerp.h:



This graph shows which files directly or indirectly include this file:


/usr/local/michalos
/nistfanuc_ws/src/gomotion
/include/gomotion/gointerp.h
/usr/local/michalos
/nistfanuc_ws/src/gomotion
/src/gointerp.cpp
/usr/local/michalos
/nistfanuc_ws/src/gomotion
/src/gomove.cpp
/usr/local/michalos
/nistfanuc_ws/src/gomotion
/src/gotraj.cpp

Data Structures

- struct gomotion::points

  This structure holds the points to be interpolated.
- struct gomotion::coeff

  This structure holds the polynomial coefficients.
- class gomotion::go_interp

  The interpolator structure.

Namespaces

- gomotion

Enumerations

- enum { gomotion::COEFF_MAX = 6 }

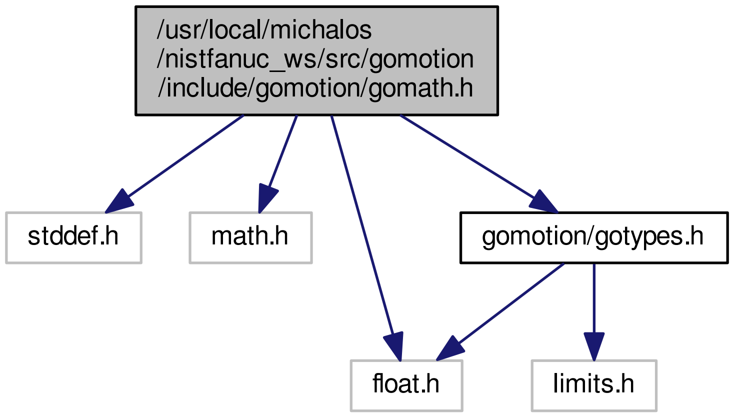
  How many coefficients we support, one more than max polynomial degree.

8.2 /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomath.h File Reference

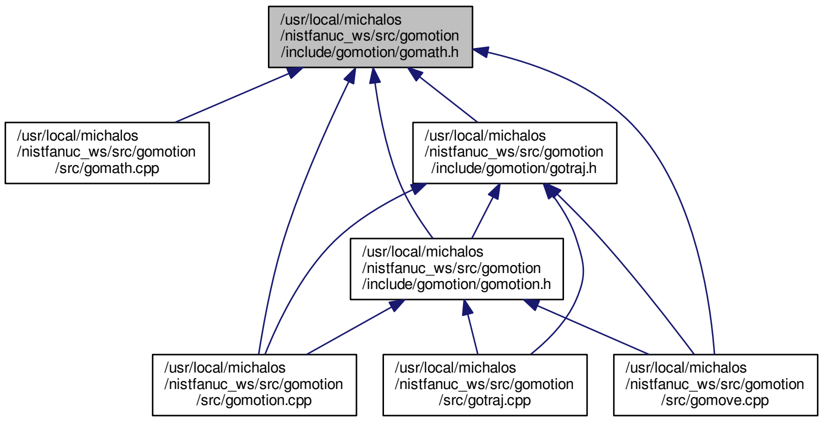
Declarations for pose math functions.

```
#include <stddef.h>
#include <math.h>
#include <float.h>
#include "gomotion/gotypes.h"
```

Include dependency graph for gomath.h:



This graph shows which files directly or indirectly include this file:


/usr/local/michalos
/nistfanuc_ws/src/gomotion
/include/gomotion/gomath.h
/usr/local/michalos
/nistfanuc_ws/src/gomotion
/src/gomath.cpp
/usr/local/michalos
/nistfanuc_ws/src/gomotion
/include/gomotion/gotraj.h
/usr/local/michalos
/nistfanuc_ws/src/gomotion
/include/gomotion/gomotion.h
/usr/local/michalos
/nistfanuc_ws/src/gomotion
/src/gomotion.cpp
/usr/local/michalos
/nistfanuc_ws/src/gomotion
/src/gotraj.cpp
/usr/local/michalos
/nistfanuc_ws/src/gomotion
/src/gomove.cpp

Data Structures

- struct gomotion::go_cart
- struct gomotion::go_sph
- struct gomotion::go_cyl
- struct gomotion::go_rvec
- struct gomotion::go_mat
- struct gomotion::go_quat

- struct gomotion::go_zyz
- struct gomotion::go_zyx
- struct gomotion::go_xyz
- struct gomotion::go_rpy
- struct gomotion::go_uxz
- struct gomotion::go_pose
- struct gomotion::go_vel
- struct gomotion::go_hom
- struct gomotion::go_line
- struct gomotion::go_plane
- struct gomotion::go_matrix
- struct gomotion::go_dh
- struct gomotion::go_pk
- struct gomotion::go_pp
- struct gomotion::go_body
- struct gomotion::go_link
- struct gomotion::go_complex
- struct gomotion::go_quadratic
- struct gomotion::go_cubic
- struct gomotion::go_quartic

Namespaces

- gomotion

Macros

- #define go_sq(x) ((x)∗(x))
- #define go_cub(x) ((x)∗(x)∗(x))
- #define go_qua(x) ((x)∗(x)∗(x)∗(x))
- #define GO_PI 3.14159265358979323846
- #define GO_2_PI (2.0∗GO_PI)
- #define GO_PI_2 1.57079632679489661923
- #define GO_PI_4 0.78539816339744830962
- #define GO_TO_DEG(rad) ((rad)∗57.295779513082323)
- #define GO_TO_RAD(deg) ((deg)∗0.0174532925199432952)
- #define GO_TRAN_CLOSE(x, y) (fabs((x)-(y)) < GO_REAL_EPSILON)
- #define GO_TRAN_SMALL(x) (fabs(x) < GO_REAL_EPSILON)
- #define GO_ROT_CLOSE(x, y) (fabs((x)-(y)) < GO_REAL_EPSILON)
- #define GO_ROT_SMALL(x) (fabs(x) < GO_REAL_EPSILON)
- #define GO_CLOSE(x, y) (fabs((x)-(y)) < GO_REAL_EPSILON)
- #define GO_SMALL(x) (fabs(x) < GO_REAL_EPSILON)
- #define GO_MATRIX_DECLARE(M, Mspace, _rows, _cols)
- #define ISIZEOF(x) ((int) sizeof(x))
- #define go_matrix_init(M, Mspace, _rows, _cols)
- #define go_body_init(b)
- #define go_body_copy(src, dst)
- #define go_link_to_string(L)

Typedefs

- typedef go_real gomotion::go_vector

Enumerations

- enum { gomotion::GO_LINK_DH = 1, gomotion::GO_LINK_PK, gomotion::GO_LINK_PP }

Functions

- void gomotion::go_sincos (go_real t, go_real ∗s, go_real ∗c)
- go_real gomotion::go_cbrt (go_real x)
- go_result gomotion::go_asines (go_real s, go_real ∗asp, go_real ∗asn)
- go_result gomotion::go_acoses (go_real c, go_real ∗acp, go_real ∗acn)
- go_result gomotion::go_atans (go_real t, go_real ∗atp, go_real ∗atn)
- go_pose gomotion::go_pose_this (go_real x, go_real y, go_real z, go_real rs, go_real rx, go_real ry, go_real rz)
- go_cart gomotion::go_cart_zero (void)
- go_quat gomotion::go_quat_identity (void)
- go_pose gomotion::go_pose_identity (void)
- go_result gomotion::go_line_from_point_direction (const go_cart ∗point, const go_cart ∗direction, go_line ∗line)
- go_result gomotion::go_line_from_points (const go_cart ∗point1, const go_cart ∗point2, go_line ∗line)
- go_result gomotion::go_line_from_planes (const go_plane ∗plane1, const go_plane ∗plane2, go_line ∗line)
- go_flag gomotion::go_line_line_compare (const go_line ∗line1, const go_line ∗line2)
- go_result gomotion::go_line_evaluate (const go_line ∗line, go_real d, go_cart ∗point)
- go_result gomotion::go_point_line_distance (const go_cart ∗point, const go_line ∗line, go_real ∗distance)
- go_result gomotion::go_point_line_proj (const go_cart ∗point, const go_line ∗line, go_cart ∗pout)
- go_result gomotion::go_point_plane_proj (const go_cart ∗point, const go_plane ∗plane, go_cart ∗proj)
- go_result gomotion::go_line_plane_proj (const go_line ∗line, const go_plane ∗plane, go_line ∗proj)
- go_result gomotion::go_plane_from_point_normal (const go_cart ∗point, const go_cart ∗normal, go_plane ∗plane)
- go_result gomotion::go_plane_from_abcd (go_real A, go_real B, go_real C, go_real D, go_plane ∗plane)
- go_result gomotion::go_plane_from_points (const go_cart ∗point1, const go_cart ∗point2, const go_cart ∗point3, go_plane ∗plane)
- go_result gomotion::go_plane_from_point_line (const go_cart ∗point, const go_line ∗line, go_plane ∗plane)
- go_flag gomotion::go_plane_plane_compare (const go_plane ∗plane1, const go_plane ∗plane2)
- go_result gomotion::go_point_plane_distance (const go_cart ∗point, const go_plane ∗plane, go_real ∗distance)
- go_result gomotion::go_plane_evaluate (const go_plane ∗plane, go_real u, go_real v, go_cart ∗point)
- go_result gomotion::go_line_plane_intersect (const go_line ∗line, const go_plane ∗plane, go_cart ∗point, go_real ∗distance)
- go_result gomotion::go_cart_sph_convert (const go_cart ∗v, go_sph ∗s)
- go_result gomotion::go_cart_cyl_convert (const go_cart ∗v, go_cyl ∗c)
- go_result gomotion::go_sph_cart_convert (const go_sph ∗s, go_cart ∗v)
- go_result gomotion::go_sph_cyl_convert (const go_sph ∗s, go_cyl ∗c)
- go_result gomotion::go_cyl_cart_convert (const go_cyl ∗c, go_cart ∗v)
- go_result gomotion::go_cyl_sph_convert (const go_cyl ∗c, go_sph ∗s)
- go_result gomotion::go_rvec_quat_convert (const go_rvec ∗r, go_quat ∗q)
- go_result gomotion::go_rvec_mat_convert (const go_rvec ∗r, go_mat ∗m)
- go_result gomotion::go_rvec_zyz_convert (const go_rvec ∗rvec, go_zyz ∗zyz)
- go_result gomotion::go_rvec_zyx_convert (const go_rvec ∗rvec, go_zyx ∗zyx)
- go_result gomotion::go_rvec_xyz_convert (const go_rvec ∗, go_xyz ∗)

- go_result gomotion::go_rvec_rpy_convert (const go_rvec ∗r, go_rpy ∗rpy)
- go_result gomotion::go_quat_rvec_convert (const go_quat ∗q, go_rvec ∗r)
- go_result gomotion::go_quat_mat_convert (const go_quat ∗q, go_mat ∗m)
- go_result gomotion::go_quat_zyz_convert (const go_quat ∗q, go_zyz ∗zyz)
- go_result gomotion::go_quat_zyx_convert (const go_quat ∗q, go_zyx ∗zyx)
- go_result gomotion::go_quat_xyz_convert (const go_quat ∗, go_xyz ∗)
- go_result gomotion::go_quat_rpy_convert (const go_quat ∗q, go_rpy ∗rpy)
- go_result gomotion::go_mat_rvec_convert (const go_mat ∗m, go_rvec ∗r)
- go_result gomotion::go_mat_quat_convert (const go_mat ∗m, go_quat ∗q)
- go_result gomotion::go_mat_zyz_convert (const go_mat ∗m, go_zyz ∗zyz)
- go_result gomotion::go_mat_zyx_convert (const go_mat ∗m, go_zyx ∗zyx)
- go_result gomotion::go_mat_xyz_convert (const go_mat ∗m, go_xyz ∗xyz)
- go_result gomotion::go_mat_rpy_convert (const go_mat ∗m, go_rpy ∗rpy)
- go_result gomotion::go_zyz_rvec_convert (const go_zyz ∗zyz, go_rvec ∗r)
- go_result gomotion::go_zyz_quat_convert (const go_zyz ∗zyz, go_quat ∗q)
- go_result gomotion::go_zyz_mat_convert (const go_zyz ∗zyz, go_mat ∗m)
- go_result gomotion::go_zyz_zyx_convert (const go_zyz ∗zyz, go_zyx ∗zyx)
- go_result gomotion::go_zyz_xyz_convert (const go_zyz ∗, go_xyz ∗)
- go_result gomotion::go_zyz_rpy_convert (const go_zyz ∗zyz, go_rpy ∗rpy)
- go_result gomotion::go_zyx_rvec_convert (const go_zyx ∗zyx, go_rvec ∗r)
- go_result gomotion::go_zyx_quat_convert (const go_zyx ∗zyx, go_quat ∗q)
- go_result gomotion::go_zyx_mat_convert (const go_zyx ∗zyx, go_mat ∗m)
- go_result gomotion::go_zyx_zyz_convert (const go_zyx ∗zyx, go_zyz ∗zyz)
- go_result gomotion::go_zyx_xyz_convert (const go_zyx ∗, go_xyz ∗)
- go_result gomotion::go_zyx_rpy_convert (const go_zyx ∗zyx, go_rpy ∗rpy)
- go_result gomotion::go_xyz_rvec_convert (const go_xyz ∗, go_rvec ∗)
- go_result gomotion::go_xyz_quat_convert (const go_xyz ∗, go_quat ∗)
- go_result gomotion::go_xyz_mat_convert (const go_xyz ∗xyz, go_mat ∗m)
- go_result gomotion::go_xyz_zyz_convert (const go_xyz ∗, go_zyz ∗)
- go_result gomotion::go_xyz_zyx_convert (const go_xyz ∗, go_zyx ∗)
- go_result gomotion::go_xyz_rpy_convert (const go_xyz ∗, go_rpy ∗)
- go_result gomotion::go_rpy_rvec_convert (const go_rpy ∗rpy, go_rvec ∗rvec)
- go_result gomotion::go_rpy_quat_convert (const go_rpy ∗rpy, go_quat ∗quat)
- go_result gomotion::go_rpy_mat_convert (const go_rpy ∗rpy, go_mat ∗m)
- go_result gomotion::go_rpy_zyz_convert (const go_rpy ∗rpy, go_zyz ∗zyz)
- go_result gomotion::go_rpy_zyx_convert (const go_rpy ∗rpy, go_zyx ∗zyx)
- go_result gomotion::go_rpy_xyz_convert (const go_rpy ∗, go_xyz ∗)
- go_result gomotion::go_uxz_mat_convert (const go_uxz ∗uxz, go_mat ∗mat)
- go_result gomotion::go_mat_uxz_convert (const go_mat ∗mat, go_uxz ∗uxz)
- go_result gomotion::go_pose_hom_convert (const go_pose ∗p, go_hom ∗h)
- go_result gomotion::go_hom_pose_convert (const go_hom ∗h, go_pose ∗p)
- go_result gomotion::go_cart_rvec_convert (const go_cart ∗cart, go_rvec ∗rvec)
- go_result gomotion::go_rvec_cart_convert (const go_rvec ∗rvec, go_cart ∗cart)
- go_flag gomotion::go_cart_cart_compare (const go_cart ∗v1, const go_cart ∗v2)
- go_result gomotion::go_cart_cart_dot (const go_cart ∗v1, const go_cart ∗v2, go_real ∗d)
- go_result gomotion::go_cart_cart_cross (const go_cart ∗v1, const go_cart ∗v2, go_cart ∗vout)
- go_result gomotion::go_cart_mag (const go_cart ∗v, go_real ∗d)
- go_result gomotion::go_cart_magsq (const go_cart ∗v, go_real ∗d)
- go_flag gomotion::go_cart_cart_par (const go_cart ∗v1, const go_cart ∗v2)
- go_flag gomotion::go_cart_cart_perp (const go_cart ∗v1, const go_cart ∗v2)
- go_result gomotion::go_cart_cart_disp (const go_cart ∗v1, const go_cart ∗v2, go_real ∗d)

- go_result gomotion::go_cart_cart_add (const go_cart ∗v1, const go_cart ∗v2, go_cart ∗vout)
- go_result gomotion::go_cart_cart_sub (const go_cart ∗v1, const go_cart ∗v2, go_cart ∗vout)
- go_result gomotion::go_cart_scale_mult (const go_cart ∗v1, go_real d, go_cart ∗vout)
- go_result gomotion::go_cart_neg (const go_cart ∗v1, go_cart ∗vout)
- go_result gomotion::go_cart_unit (const go_cart ∗v, go_cart ∗vout)
- go_result gomotion::go_cart_cart_rot (const go_cart ∗v1, const go_cart ∗v2, go_quat ∗quat)
- go_result gomotion::go_cart_cart_proj (const go_cart ∗v1, const go_cart ∗v2, go_cart ∗vout)
- go_result gomotion::go_cart_plane_proj (const go_cart ∗v, const go_cart ∗normal, go_cart ∗vout)
- go_result gomotion::go_cart_cart_angle (const go_cart ∗v1, const go_cart ∗v2, go_real ∗a)
- go_result gomotion::go_cart_normal (const go_cart ∗v, go_cart ∗vout)
- go_result gomotion::go_cart_centroid (const go_cart ∗varray, go_integer num, go_cart ∗centroid)
- go_result gomotion::go_cart_centroidize (const go_cart ∗vinarray, go_integer num, go_cart ∗centroid, go_cart ∗voutarray)
- go_result gomotion::go_cart_cart_pose (const go_cart ∗v1, const go_cart ∗v2, go_cart ∗v1c, go_cart ∗v2c, go_integer num, go_pose ∗pout)
- go_result gomotion::go_cart_trilaterate (const go_cart ∗c1, const go_cart ∗c2, const go_cart ∗c3, go_real l1, go_real l2, go_real l3, go_cart ∗out1, go_cart ∗out2)
- go_flag gomotion::go_quat_quat_compare (const go_quat ∗q1, const go_quat ∗q2)
- go_result gomotion::go_quat_mag (const go_quat ∗quat, go_real ∗d)
- go_result gomotion::go_quat_unit (const go_quat ∗q1, go_quat ∗qout)
- go_result gomotion::go_quat_norm (const go_quat ∗q1, go_quat ∗qout)
- go_result gomotion::go_quat_inv (const go_quat ∗q1, go_quat ∗qout)
- go_flag gomotion::go_quat_is_norm (const go_quat ∗q1)
- go_result gomotion::go_quat_scale_mult (const go_quat ∗q, go_real s, go_quat ∗qout)
- go_result gomotion::go_quat_quat_mult (const go_quat ∗q1, const go_quat ∗q2, go_quat ∗qout)
- go_result gomotion::go_quat_cart_mult (const go_quat ∗q1, const go_cart ∗v2, go_cart ∗vout)
- go_flag gomotion::go_rvec_rvec_compare (const go_rvec ∗r1, const go_rvec ∗r2)
- go_result gomotion::go_rvec_scale_mult (const go_rvec ∗r, go_real s, go_rvec ∗rout)
- go_result gomotion::go_rpy_cart_mult (const go_rpy ∗rpy, const go_cart ∗in, go_cart ∗out)
- go_result gomotion::go_mat_norm (const go_mat ∗mat, go_mat ∗mout)
- go_flag gomotion::go_mat_is_norm (const go_mat ∗m)
- go_result gomotion::go_mat_inv (const go_mat ∗m, go_mat ∗mout)
- go_result gomotion::go_mat_cart_mult (const go_mat ∗m, const go_cart ∗v, go_cart ∗vout)
- go_result gomotion::go_mat_mat_mult (const go_mat ∗m1, const go_mat ∗m2, go_mat ∗mout)
- go_flag gomotion::go_pose_pose_compare (const go_pose ∗p1, const go_pose ∗p2)
- go_result gomotion::go_pose_inv (const go_pose ∗p1, go_pose ∗p2)
- go_result gomotion::go_pose_cart_mult (const go_pose ∗p1, const go_cart ∗v2, go_cart ∗vout)
- go_result gomotion::go_pose_pose_mult (const go_pose ∗p1, const go_pose ∗p2, go_pose ∗pout)
- go_result gomotion::go_pose_scale_mult (const go_pose ∗p1, go_real s, go_pose ∗pout)
- go_result gomotion::go_pose_pose_interp (go_real t1, const go_pose ∗p1, go_real t2, const go_pose ∗p2, go_real t3, go_pose ∗p3)
- go_result gomotion::go_hom_inv (const go_hom ∗h1, go_hom ∗h2)
- go_result gomotion::go_hom_hom_mult (const go_hom ∗h1, const go_hom ∗h2, go_hom ∗hout)
- go_result gomotion::go_pose_vel_mult (const go_pose ∗pose, const go_vel ∗vel, go_vel ∗out)
- go_real gomotion::go_get_singular_epsilon (void)
- go_result gomotion::go_set_singular_epsilon (go_real epsilon)
- go_result gomotion::ludcmp (go_real ∗∗a, go_real ∗scratchrow, go_integer n, go_integer ∗indx, go_real ∗d)
- go_result gomotion::lubksb (go_real ∗∗a, go_integer n, go_integer ∗indx, go_real ∗b)
- go_result gomotion::go_cart_vector_convert (const go_cart ∗c, go_real ∗v)
- go_result gomotion::go_vector_cart_convert (const go_real ∗v, go_cart ∗c)
- go_result gomotion::go_quat_matrix_convert (const go_quat ∗quat, go_matrix ∗matrix)

- go_result gomotion::go_mat_matrix_convert (const go_mat ∗mat, go_matrix ∗matrix)
- go_result gomotion::go_matrix_matrix_add (const go_matrix ∗a, const go_matrix ∗b, go_matrix ∗apb)
- go_result gomotion::go_matrix_matrix_copy (const go_matrix ∗src, go_matrix ∗dst)
- go_result gomotion::go_matrix_matrix_mult (const go_matrix ∗a, const go_matrix ∗b, go_matrix ∗ab)
- go_result gomotion::go_matrix_vector_mult (const go_matrix ∗a, const go_vector ∗v, go_vector ∗axv)
- go_result gomotion::go_matrix_vector_cross (const go_matrix ∗a, const go_vector ∗v, go_matrix ∗axv)
- go_result gomotion::go_matrix_transpose (const go_matrix ∗a, go_matrix ∗at)
- go_result gomotion::go_matrix_inv (const go_matrix ∗m, go_matrix ∗minv)
- go_result gomotion::go_mat3_inv (go_real a[3][3], go_real ainv[3][3])
- go_result gomotion::go_mat3_mat3_mult (go_real a[3][3], go_real b[3][3], go_real axb[3][3])
- go_result gomotion::go_mat3_vec3_mult (go_real a[3][3], go_real v[3], go_real axv[3])
- go_result gomotion::go_mat4_inv (go_real a[4][4], go_real ainv[4][4])
- go_result gomotion::go_mat4_mat4_mult (go_real a[4][4], go_real b[4][4], go_real axb[4][4])
- go_result gomotion::go_mat4_vec4_mult (go_real a[4][4], go_real v[4], go_real axv[4])
- go_result gomotion::go_mat6_inv (go_real a[6][6], go_real ainv[6][6])
- go_result gomotion::go_mat6_transpose (go_real a[6][6], go_real at[6][6])
- go_result gomotion::go_mat6_mat6_mult (go_real a[6][6], go_real b[6][6], go_real axb[6][6])
- go_result gomotion::go_mat6_vec6_mult (go_real a[6][6], go_real v[6], go_real axv[6])
- go_result gomotion::go_dh_hom_convert (const go_dh ∗dh, go_hom ∗h)
- go_result gomotion::go_dh_pose_convert (const go_dh ∗dh, go_pose ∗p)
- go_result gomotion::go_pose_dh_convert (const go_pose ∗p, go_dh ∗dh)
- go_result gomotion::go_hom_dh_convert (const go_hom ∗h, go_dh ∗dh)
- go_result gomotion::go_link_joint_set (const go_link ∗link, go_real joint, go_link ∗linkout)
- go_result gomotion::go_link_pose_build (const go_link ∗link_params, go_integer num, go_pose ∗pose)
- go_complex gomotion::go_complex_add (go_complex z1, go_complex z2)
- go_complex gomotion::go_complex_sub (go_complex z1, go_complex z2)
- go_complex gomotion::go_complex_mult (go_complex z1, go_complex z2)
- go_complex gomotion::go_complex_inv (go_complex z, go_result ∗result)
- go_complex gomotion::go_complex_div (go_complex z1, go_complex z2, go_result ∗result)
- go_complex gomotion::go_complex_sq (go_complex z)
- go_complex gomotion::go_complex_scale (go_complex z, go_real scale)
- go_real gomotion::go_complex_mag (go_complex z)
- go_real gomotion::go_complex_magsq (go_complex z)
- go_real gomotion::go_complex_arg (go_complex z)
- void gomotion::go_complex_sqrt (go_complex z, go_complex ∗z1, go_complex ∗z2)
- void gomotion::go_complex_cbrt (go_complex z, go_complex ∗z1, go_complex ∗z2, go_complex ∗z3)
- go_result gomotion::go_quadratic_solve (const go_quadratic ∗quad, go_complex ∗z1, go_complex ∗z2)
- go_result gomotion::go_cubic_solve (const go_cubic ∗cub, go_complex ∗z1, go_complex ∗z2, go_complex ∗z3)
- go_result gomotion::go_quartic_solve (const go_quartic ∗quart, go_complex ∗z1, go_complex ∗z2, go_complex ∗z3, go_complex ∗z4)
- go_result gomotion::go_tridiag_reduce (go_real ∗∗a, go_integer n, go_real ∗d, go_real ∗e)
- go_result gomotion::go_tridiag_ql (go_real ∗d, go_real ∗e, go_integer n, go_real ∗∗z)
- go_result gomotion::go_linear_cos_sin_solve (go_real a, go_real b, go_real ∗th1, go_real ∗th2)

8.2.1 Detailed Description

Declarations for pose math functions.

8.2.2 Macro Definition Documentation

8.2.2.1 #define GO_2_PI (2.0∗GO_PI)

The value of twice Pi.

8.2.2.2 #define go_body_copy(*src, dst*)

Value:

```
(dst)->mass = (src)->mass;                         \
(dst)->inertia[0][0] = (src)->inertia[0][0];     \
(dst)->inertia[0][1] = (src)->inertia[0][1];     \
(dst)->inertia[0][2] = (src)->inertia[0][2];     \
(dst)->inertia[1][0] = (src)->inertia[1][0];     \
(dst)->inertia[1][1] = (src)->inertia[1][1];     \
(dst)->inertia[1][2] = (src)->inertia[1][2];     \
(dst)->inertia[2][0] = (src)->inertia[2][0];     \
(dst)->inertia[2][1] = (src)->inertia[2][1];     \
(dst)->inertia[2][2] = (src)->inertia[2][2]
```

8.2.2.3 #define go_body_init(*b*)

Value:

```
(b)->mass = 1;                                     \
(b)->inertia[0][0] = 1;                            \
(b)->inertia[0][1] = 0;                            \
(b)->inertia[0][2] = 0;                            \
(b)->inertia[1][0] = 0;                            \
(b)->inertia[1][1] = 1;                            \
(b)->inertia[1][2] = 0;                            \
(b)->inertia[2][0] = 0;                            \
(b)->inertia[2][1] = 0;                            \
(b)->inertia[2][2] = 1
```

8.2.2.4 #define GO_CLOSE(*x, y*) (fabs((x)-(y)) < GO_REAL_EPSILON)

How close general quantities must be to be equal. Use this when you have something other than translational or rotational quantities, otherwise use one of *GO_TRAN*,ROT_CLOSE.

8.2.2.5 #define go_cub(*x*) ((x)∗(x)∗(x))

Returns the cube of *x*.

8.2.2.6 #define go_link_to_string(*L*)

Value:

```
(L) == GO_LINK_DH ? "DH" :              \
(L) == GO_LINK_PK ? "PK" :              \
(L) == GO_LINK_PP ? "PP" : "None"
```

8.2.2.7 #define GO_MATRIX_DECLARE(*M,* *Mspace,* *_rows,* *_cols*)

Value:

```
go_matrix M = {0, 0, 0, 0, 0, 0}; \
struct { \
  go_real *el[_rows]; \
  go_real *elcpy[_rows]; \
  go_real stg[_rows][_cols]; \
  go_real stgcpy[_rows][_cols]; \
  go_real v[_rows]; \
  go_integer index[_rows]; \
} Mspace
```

8.2.2.8 #define go_matrix_init(*M,* *Mspace,* *_rows,* *_cols*)

Value:

```
M.el = Mspace.el;                                  \
M.elcpy = Mspace.elcpy;                            \
 for (M.rows = 0; M.rows < (_rows) && M.rows < ISIZEOF(Mspace.el)/ISIZEOF(*(Mspace.el)); M.
      rows++) { \
  M.el[M.rows] = Mspace.stg[M.rows];         \
  M.elcpy[M.rows] = Mspace.stgcpy[M.rows];         \
} \
M.cols = (_cols) < ISIZEOF(Mspace.stg[0])/ISIZEOF(*(Mspace.stg[0])) ? (_cols) :
      ISIZEOF(Mspace.stg[0])/ISIZEOF(*(Mspace.stg[0])); \
M.v = Mspace.v; \
M.index = Mspace.index
```

8.2.2.9 #define GO_PI 3.14159265358979323846

The value of Pi.

8.2.2.10 #define GO_PI_2 1.57079632679489661923

The value of half of Pi.

8.2.2.11 #define GO_PI_4 0.78539816339744830962

The value of one-fourth of Pi.

8.2.2.12 #define go_qua(*x*) ((x)*(x)*(x)*(x))

Returns *x* to the fourth power.

8.2.2.13 #define GO_ROT_CLOSE(*x,* *y*) (fabs((x)-(y)) < GO_REAL_EPSILON)

How close rotational quantities must be to be equal.

8.2.2.14 #define GO_ROT_SMALL(*x*) (fabs(x) < GO_REAL_EPSILON)

How small a rotational quantity must be to be zero.

8.2.2.15 #define GO_SMALL(*x*) (fabs(x) < GO_REAL_EPSILON)

How small a general quantity must be to be zero. Use this when you have something other than a translational or rotational quantity, otherwise use one of *GO_TRAN*,ROT_SMALL.

8.2.2.16 #define go_sq(*x*) ((x)∗(x))

Returns the square of *x*.

8.2.2.17 #define GO_TO_DEG(*rad*) ((rad)∗57.295779513082323)

Returns *rad* in radians as its value in degrees.

8.2.2.18 #define GO_TO_RAD(*deg*) ((deg)∗0.0174532925199432952)

Returns *deg* in degrees as its value in radians.

8.2.2.19 #define GO_TRAN_CLOSE(*x*, *y*) (fabs((x)-(y)) < GO_REAL_EPSILON)

How close translational quantities must be to be equal.

8.2.2.20 #define GO_TRAN_SMALL(*x*) (fabs(x) < GO_REAL_EPSILON)

How small a translational quantity must be to be zero.

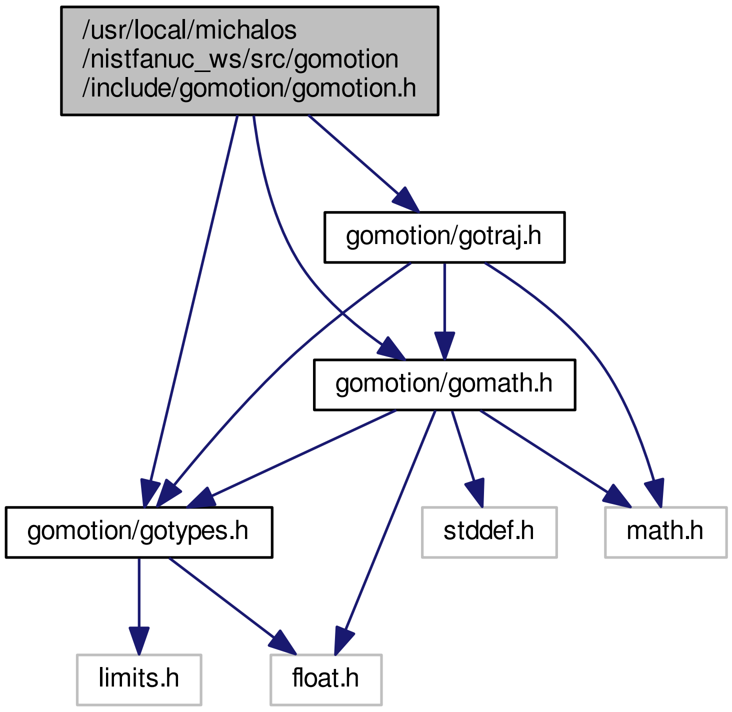
8.2.2.21 #define ISIZEOF(*x*) ((int) sizeof(x))

8.3 /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomotion.h File Reference

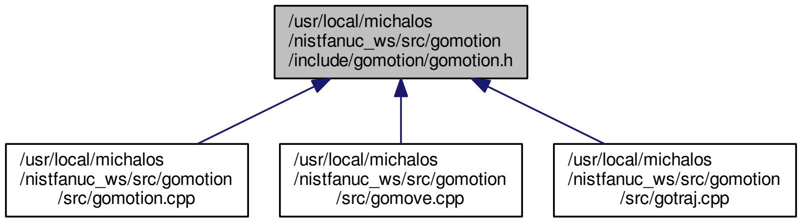
Declarations for motion queue manipulation.

```
#include "gomotion/gotypes.h"
#include "gomotion/gomath.h"
#include "gomotion/gotraj.h"
```

Include dependency graph for gomotion.h:



This graph shows which files directly or indirectly include this file:


/usr/local/michalos
/nistfanuc_ws/src/gomotion
/include/gomotion/gomotion.h
/usr/local/michalos
/nistfanuc_ws/src/gomotion
/src/gomotion.cpp
/usr/local/michalos
/nistfanuc_ws/src/gomotion
/src/gomove.cpp
/usr/local/michalos
/nistfanuc_ws/src/gomotion
/src/gotraj.cpp

Data Structures

- struct gomotion::go_position

    Depending upon whether you are doing joint interpolation or world coordinate interpolation (as specified by your call to go_motion_queue_set_type()), fill in joint[] or pose accordingly.

- struct gomotion::go_motion_params
- struct gomotion::go_motion_linear_params

  In the following comments, LIN, CIR and ALL refer to linear moves, circular moves and both, respectively.
- struct gomotion::go_motion_circular_params
- struct gomotion::go_motion_spec
- struct gomotion::go_scale_spec
- struct gomotion::go_motion_queue

Namespaces

- gomotion

Macros

- #define GO_MOTION_JOINT_NUM 8 /∗∗ number of joints supported ∗/

Enumerations

- enum {
  gomotion::GO_MOTION_NONE, gomotion::GO_MOTION_JOINT, gomotion::GO_MOTION_UJOINT, gomotion-::GO_MOTION_WORLD,
  gomotion::GO_MOTION_LINEAR, gomotion::GO_MOTION_CIRCULAR }

8.3.1 Detailed Description

Declarations for motion queue manipulation.

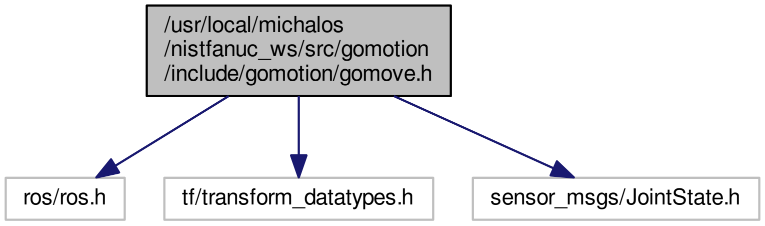
8.3.2 Macro Definition Documentation

8.3.2.1 #define GO_MOTION_JOINT_NUM 8 /∗∗ number of joints supported ∗/

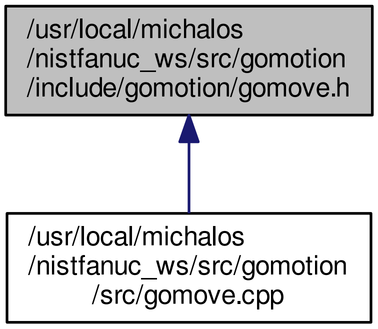
8.4 /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gomove.h File Reference

```
#include <ros/ros.h>
#include <tf/transform_datatypes.h>
#include <sensor_msgs/JointState.h>
```

Include dependency graph for gomove.h:



This graph shows which files directly or indirectly include this file:


/usr/local/michalos
/nistfanuc_ws/src/gomotion
/include/gomotion/gomove.h
/usr/local/michalos
/nistfanuc_ws/src/gomotion
/src/gomove.cpp

Data Structures

- struct gomotion::GoMotionParams
- class gomotion::GoMotion

Namespaces

- gomotion

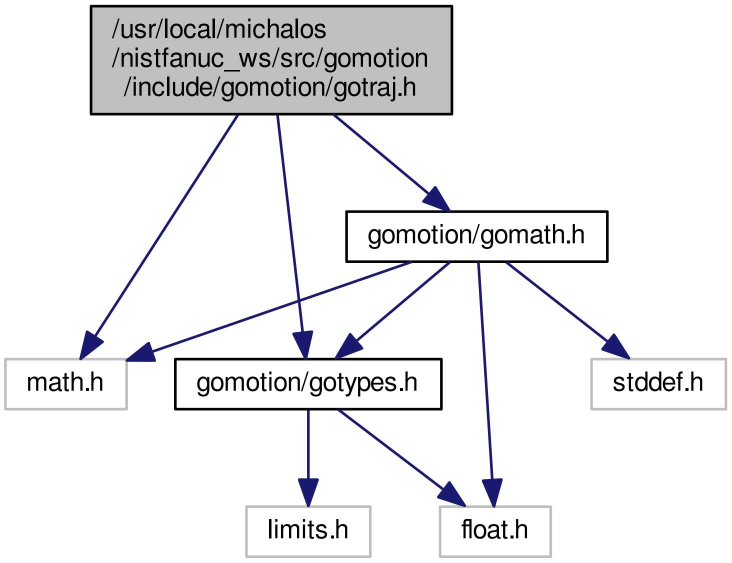
Typedefs

- typedef
  sensor_msgs::JointState_
  < std::allocator< void > > gomotion::JointState

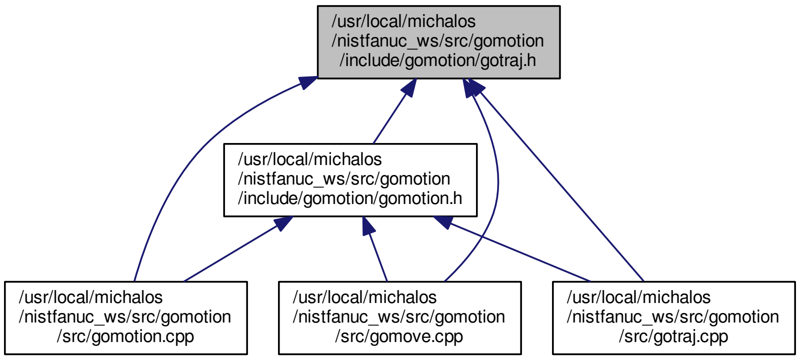
8.5 /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gotraj.h File Reference

```
#include <math.h>
#include "gomotion/gotypes.h"
#include "gomotion/gomath.h"
```

Include dependency graph for gotraj.h:



This graph shows which files directly or indirectly include this file:


/usr/local/michalos
/nistfanuc_ws/src/gomotion
/include/gomotion/gotraj.h
/usr/local/michalos
/nistfanuc_ws/src/gomotion
/include/gomotion/gomotion.h
/usr/local/michalos
/nistfanuc_ws/src/gomotion
/src/gomotion.cpp
/usr/local/michalos
/nistfanuc_ws/src/gomotion
/src/gomove.cpp
/usr/local/michalos
/nistfanuc_ws/src/gomotion
/src/gotraj.cpp

Data Structures

- struct gomotion::go_traj_ca_spec
- struct gomotion::go_traj_cj_spec
- struct gomotion::go_traj_interp_spec

Namespaces

- gomotion

Macros

- #define reciprocate(x) (x) <= 0.0 ? GO_INF : 1.0 / (x)

Functions

- go_result gomotion::go_traj_ca_generate (go_real acc, go_real deltacc, go_real deltvel, go_traj_ca_spec ∗pts)

  go_traj_ca_generate() takes an accel value, and intervals for the accel period and cruise period, and fills in the go_traj_-ca_spec with the interval parameters.
- go_result gomotion::go_traj_ca_compute (go_real d, go_real v, go_real a, go_traj_ca_spec ∗pts)

  go_traj_ca_compute() takes values for distance 'd' to move, max velocity 'v' to limit if necessary, and constant accel 'a', and fills in the go_traj_ca_spec with the interval parameters.
- go_result gomotion::go_traj_ca_scale (const go_traj_ca_spec ∗ts, go_real t, go_traj_ca_spec ∗pts)

  go_traj_ca_scale() takes a time 't' for the desired time of the motion, and scales the times and motion params so that the total distance remains the same and everything else is in proportion
- go_result gomotion::go_traj_ca_stop (const go_traj_ca_spec ∗ts, go_real t, go_traj_ca_spec ∗pts)

  go_traj_ca_stop() takes a time 't' for the desired time to begin stopping, and recomputes the times so that the move will stop as soon as possible during subsequent interps.
- go_result gomotion::go_traj_ca_extend (const go_traj_ca_spec ∗ts, go_real t, go_traj_ca_spec ∗pts)

  go_traj_ca_extend() takes a time 't' for the desired time to finish the motion, and extends the constant-speed section so that it stops then.
- go_result gomotion::go_traj_ca_interp (const go_traj_ca_spec ∗ts, go_real t, go_traj_interp_spec ∗ti)

  go_traj_ca_interp() takes a go_traj_ca_spec and interpolates the d-v-a values for the given time t, storing the d-v-a values in ti.
- go_result gomotion::go_traj_cj_generate (go_real jrk, go_real deltjrk, go_real deltacc, go_real deltvel, go_traj_cj-_spec ∗pts)

  go_traj_cj_generate() takes a jerk value, and intervals for the jerk period, accel period and cruise period, and fills in the go_traj_cj_spec with the interval parameters.
- go_result gomotion::go_traj_cj_compute (go_real d, go_real v, go_real a, go_real j, go_traj_cj_spec ∗pts)

  go_traj_cj_compute() takes values for distance 'd' to move, max velocity 'v' to limit if necessary, max accel 'a' to limit if necessary, and constant jerk 'j', and fills in the go_traj_cj_spec with the interval parameters.
- go_result gomotion::go_traj_cj_scale (const go_traj_cj_spec ∗ts, go_real t, go_traj_cj_spec ∗pts)

  go_traj_cj_scale() takes a time 't' for the desired time of the motion, and scales the times and motion params so that the total distance remains the same and everything else is in proportion
- go_result gomotion::go_traj_cj_stop (const go_traj_cj_spec ∗ts, go_real t, go_traj_cj_spec ∗pts)

  go_traj_cj_stop() takes a time 't' for the desired time to begin stopping, and recomputes the times so that the move will stop as soon as possible during subsequent interps.
- go_result gomotion::go_traj_cj_extend (const go_traj_cj_spec ∗ts, go_real t, go_traj_cj_spec ∗pts)

  go_traj_cj_extend() takes a time 't' for the desired time to finish the motion, and extends the constant-speed section so that it stops then.

- go_result gomotion::go_traj_cj_interp (const go_traj_cj_spec ∗ts, go_real t, go_traj_interp_spec ∗ti)

  go_traj_cj_interp() takes a go_traj_cj_spec and interpolates the d-v-a-j values for the given time t, storing the d-v-a-j values in ti.
- go_result gomotion::go_traj_cj_compute_the_rest (go_traj_cj_spec ∗pts)

  ! Expects pts attributes dtend, jt0, at1, vt3, t1, t2 and t3 to be already filled in from previous calls to one of the four go_traj_cj_compute_tees functions and go_traj_cj_compute.
- go_result gomotion::go_traj_cj_compute_tees_na_nc (go_traj_cj_spec ∗pts)

  ! Computes the trajectory defining times t1, t2 and t4 for a motion with no acceleration or cruise phase, given pts filled in with dtend and jt0.
- go_result gomotion::go_traj_cj_compute_tees_a_nc (go_traj_cj_spec ∗pts)

  ! Computes the trajectory defining times t1, t2 and t4 for a motion with acceleration but no cruise phase, given pts filled in with dtend, jt0 and at1.
- go_result gomotion::go_traj_cj_compute_tees_na_c (go_traj_cj_spec ∗pts)

  ! Computes the trajectory defining times t1, t2 and t4 for a motion with no acceleration but a cruise phase, given pts filled in with dtend, jt0 and vt3.
- go_result gomotion::go_traj_cj_compute_tees_a_c (go_traj_cj_spec ∗pts)

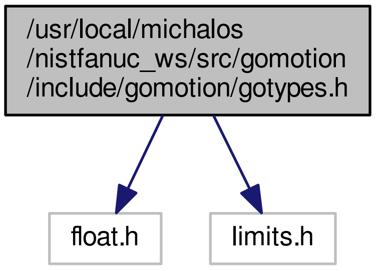
  ! Computes the trajectory defining times t1, t2 and t4 for a motion with no acceleration but a cruise phase, given pts filled in with dtend, jt0, at1 and vt3.

8.5.1 Macro Definition Documentation

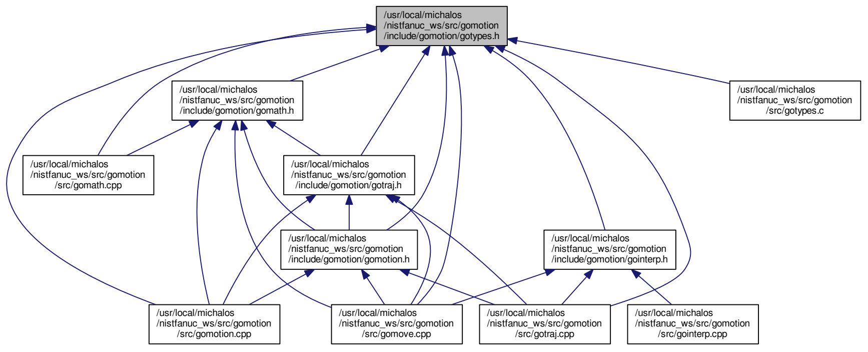
8.5.1.1 #define reciprocate(*x*) (x) <= 0.0 ? GO_INF : 1.0 / (x)

8.6 /usr/local/michalos/nistfanuc_ws/src/gomotion/include/gomotion/gotypes.h File Reference

```
#include <float.h>
#include <limits.h>
```
Include dependency graph for gotypes.h:



This graph shows which files directly or indirectly include this file:


/usr/local/michalos /nistfanuc_ws/src/gomotion /include/gomotion/gotypes.h
/usr/local/michalos /nistfanuc_ws/src/gomotion /include/gomotion/gomath.h
/usr/local/michalos /nistfanuc_ws/src/gomotion /src/gotypes.c
/usr/local/michalos /nistfanuc_ws/src/gomotion /src/gomath.cpp
/usr/local/michalos /nistfanuc_ws/src/gomotion /include/gomotion/gotraj.h
/usr/local/michalos /nistfanuc_ws/src/gomotion /include/gomotion/gomotion.h
/usr/local/michalos /nistfanuc_ws/src/gomotion /include/gomotion/gointerp.h
/usr/local/michalos /nistfanuc_ws/src/gomotion /src/gomotion.cpp
/usr/local/michalos /nistfanuc_ws/src/gomotion /src/gomove.cpp
/usr/local/michalos /nistfanuc_ws/src/gomotion /src/gotraj.cpp
/usr/local/michalos /nistfanuc_ws/src/gomotion /src/gointerp.cpp

Macros

- #define GO_RESULT_INT
- #define GO_RESULT go_result_int
- #define go_result_to_string(r)
- #define go_quantity_to_string(q)
- #define GO_REAL_DOUBLE
- #define GO_REAL go_real_double
- #define GO_REAL_MIN DBL_MIN
- #define GO_REAL_MAX DBL_MAX
- #define GO_REAL_EPSILON (1.0e-7)
- #define GO_INF DBL_MAX
- #define GO_INTEGER_INT
- #define GO_INTEGER go_integer_int
- #define GO_INTEGER_MAX INT_MAX
- #define GO_FLAG_UCHAR
- #define GO_FLAG go_flag_uchar

Typedefs

- typedef int go_result
- typedef double go_real
- typedef int go_integer
- typedef unsigned char go_flag

Enumerations

- enum {
  GO_RESULT_OK = 0, GO_RESULT_IGNORED, GO_RESULT_BAD_ARGS, GO_RESULT_RANGE_ERROR,
  GO_RESULT_DOMAIN_ERROR, GO_RESULT_ERROR, GO_RESULT_IMPL_ERROR, GO_RESULT_NORM-_ERROR,
  GO_RESULT_DIV_ERROR, GO_RESULT_SINGULAR, GO_RESULT_NO_SPACE, GO_RESULT_EMPTY,
  GO_RESULT_BUG }
- enum { GO_QUANTITY_NONE = 0, GO_QUANTITY_LENGTH, GO_QUANTITY_ANGLE }

Variables

- int go_result_int
- int go_real_double
- int go_integer_int
- int go_flag_uchar
- go_flag gocode

8.6.1 Macro Definition Documentation

8.6.1.1 #define GO_FLAG go_flag_uchar

8.6.1.2 #define GO_FLAG_UCHAR

8.6.1.3 #define GO_INF DBL_MAX

8.6.1.4 #define GO_INTEGER go_integer_int

8.6.1.5 #define GO_INTEGER_INT

8.6.1.6 #define GO_INTEGER_MAX INT_MAX

8.6.1.7 #define go_quantity_to_string(*q*)

Value:

```
(q) == GO_QUANTITY_LENGTH ? "Length" :                  \
(q) == GO_QUANTITY_ANGLE ? "Angle" : "None"
```

8.6.1.8 #define GO_REAL go_real_double

8.6.1.9 #define GO_REAL_DOUBLE

8.6.1.10 #define GO_REAL_EPSILON (1.0e-7)

8.6.1.11 #define GO_REAL_MAX DBL_MAX

8.6.1.12 #define GO_REAL_MIN DBL_MIN

8.6.1.13 #define GO_RESULT go_result_int

8.6.1.14 #define GO_RESULT_INT

8.6.1.15 #define go_result_to_string(*r*)

Value:

```
(r) == GO_RESULT_OK ? "Ok" :                                  \
(r) == GO_RESULT_IGNORED ? "Ignored" :                   \
(r) == GO_RESULT_BAD_ARGS ? "Bad Args" :               \
(r) == GO_RESULT_RANGE_ERROR ? "Range Error" :              \
(r) == GO_RESULT_DOMAIN_ERROR ? "Domain Error" :   \
(r) == GO_RESULT_ERROR ? "General Error" :                \
(r) == GO_RESULT_IMPL_ERROR ? "Implementation Error" :       \
(r) == GO_RESULT_NORM_ERROR ? "Norm Error" :                 \
(r) == GO_RESULT_DIV_ERROR ? "Div Error" :            \
(r) == GO_RESULT_SINGULAR ? "Singular" :               \
(r) == GO_RESULT_NO_SPACE ? "No Space" :               \
(r) == GO_RESULT_EMPTY ? "Empty" :                        \
(r) == GO_RESULT_BUG ? "Bug" : "?"
```

8.6.2 Typedef Documentation

8.6.2.1 typedef unsigned char **go_flag**

8.6.2.2 typedef int **go_integer**

8.6.2.3 typedef double **go_real**

8.6.2.4 typedef int **go_result**

8.6.3 Enumeration Type Documentation

8.6.3.1 anonymous enum

GO_RESULT symbols run through a small range of values, on the order of tens, suitable for a byte. GO_RESULT_OK is zero for easy detection of error conditions, e.g., if (result) { handle error }

Enumerator

GO_RESULT_OK

GO_RESULT_IGNORED

GO_RESULT_BAD_ARGS

GO_RESULT_RANGE_ERROR

GO_RESULT_DOMAIN_ERROR

GO_RESULT_ERROR

GO_RESULT_IMPL_ERROR

GO_RESULT_NORM_ERROR

GO_RESULT_DIV_ERROR

GO_RESULT_SINGULAR

GO_RESULT_NO_SPACE

GO_RESULT_EMPTY

GO_RESULT_BUG

8.6.3.2 anonymous enum

Joints are characterized by the quantities they affect, such as length for linear joints and angle for rotary joints.

Enumerator

GO_QUANTITY_NONE

GO_QUANTITY_LENGTH

GO_QUANTITY_ANGLE

8.6.4 Variable Documentation

8.6.4.1 int go_flag_uchar

8.6.4.2 int go_integer_int

8.6.4.3 int go_real_double

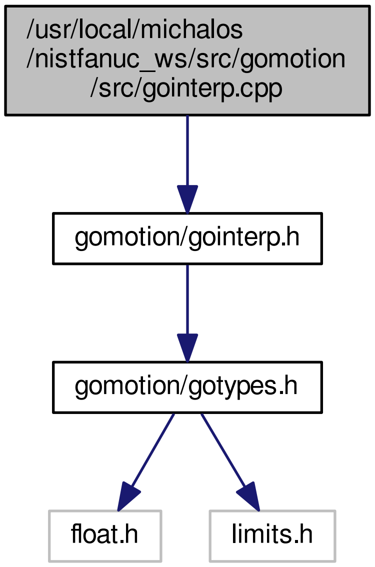
8.6.4.4 int go_result_int

8.6.4.5 go_flag gocode

An ad-hoc flag set by various functions that can be used to indicate various code paths taken.

8.7 /usr/local/michalos/nistfanuc_ws/src/gomotion/src/gointerp.cpp File Reference

`#include "gomotion/gointerp.h"`
Include dependency graph for gointerp.cpp:



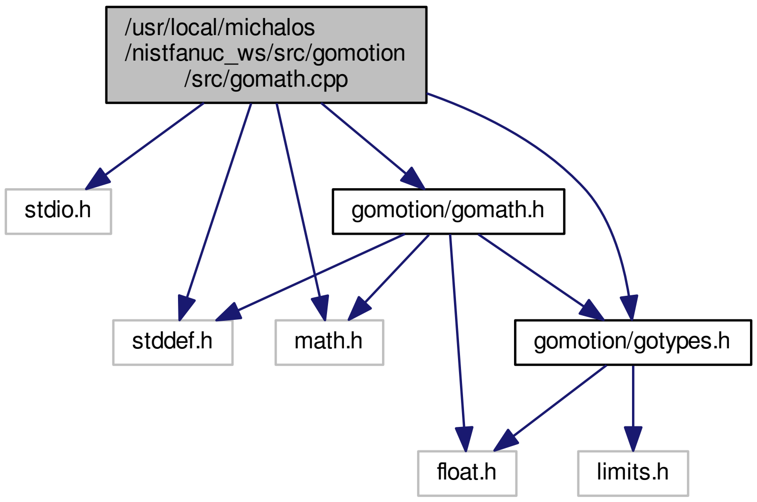
Namespaces

- gomotion

8.8 /usr/local/michalos/nistfanuc_ws/src/gomotion/src/gomath.cpp File Reference

```
#include <stdio.h>
#include <stddef.h>
#include <math.h>
#include "gomotion/gotypes.h"
#include "gomotion/gomath.h"
```

Include dependency graph for gomath.cpp:



Namespaces

- gomotion

Macros

- #define CBRT_IS_POW
- #define SIGN(a, b) ((b) >= 0.0 ? fabs(a) : -fabs(a))
- #define MAG2(a, b) sqrt((a)∗(a)+(b)∗(b))
- #define COL_IS_UNIT(r) GO_TRAN_CLOSE(go_sq((r).x) + go_sq((r).y) + go_sq((r).z), 1)

Functions

- void gomotion::sincos (double x, double ∗sx, double ∗cx)
- void gomotion::go_sincos (go_real t, go_real ∗s, go_real ∗c)
- go_result gomotion::go_asines (go_real s, go_real ∗asp, go_real ∗asn)
- go_result gomotion::go_acoses (go_real c, go_real ∗acp, go_real ∗acn)
- go_result gomotion::go_atans (go_real t, go_real ∗atp, go_real ∗atn)

- go_real gomotion::go_cbrt (go_real x)
- go_result gomotion::go_cart_sph_convert (const go_cart ∗v, go_sph ∗s)
- go_result gomotion::go_cart_cyl_convert (const go_cart ∗v, go_cyl ∗c)
- go_result gomotion::go_sph_cart_convert (const go_sph ∗s, go_cart ∗v)
- go_result gomotion::go_sph_cyl_convert (const go_sph ∗s, go_cyl ∗c)
- go_result gomotion::go_cyl_cart_convert (const go_cyl ∗c, go_cart ∗v)
- go_result gomotion::go_cyl_sph_convert (const go_cyl ∗c, go_sph ∗s)
- go_result gomotion::go_rvec_quat_convert (const go_rvec ∗r, go_quat ∗q)
- go_result gomotion::go_rvec_mat_convert (const go_rvec ∗r, go_mat ∗m)
- go_result gomotion::go_rvec_zyz_convert (const go_rvec ∗rvec, go_zyz ∗zyz)
- go_result gomotion::go_rvec_zyx_convert (const go_rvec ∗rvec, go_zyx ∗zyx)
- go_result gomotion::go_rvec_rpy_convert (const go_rvec ∗r, go_rpy ∗rpy)
- go_result gomotion::go_quat_rvec_convert (const go_quat ∗q, go_rvec ∗r)
- go_result gomotion::go_quat_mat_convert (const go_quat ∗q, go_mat ∗m)
- go_result gomotion::go_quat_zyz_convert (const go_quat ∗q, go_zyz ∗zyz)
- go_result gomotion::go_quat_zyx_convert (const go_quat ∗q, go_zyx ∗zyx)
- go_result gomotion::go_quat_rpy_convert (const go_quat ∗q, go_rpy ∗rpy)
- go_result gomotion::go_mat_rvec_convert (const go_mat ∗m, go_rvec ∗r)
- go_result gomotion::go_mat_quat_convert (const go_mat ∗m, go_quat ∗q)
- go_result gomotion::go_mat_zyz_convert (const go_mat ∗m, go_zyz ∗zyz)
- go_result gomotion::go_mat_zyx_convert (const go_mat ∗m, go_zyx ∗zyx)
- go_result gomotion::go_mat_xyz_convert (const go_mat ∗m, go_xyz ∗xyz)
- go_result gomotion::go_mat_rpy_convert (const go_mat ∗m, go_rpy ∗rpy)
- go_result gomotion::go_zyz_rvec_convert (const go_zyz ∗zyz, go_rvec ∗r)
- go_result gomotion::go_zyz_quat_convert (const go_zyz ∗zyz, go_quat ∗q)
- go_result gomotion::go_zyz_mat_convert (const go_zyz ∗zyz, go_mat ∗m)
- go_result gomotion::go_zyz_zyx_convert (const go_zyz ∗zyz, go_zyx ∗zyx)
- go_result gomotion::go_zyz_rpy_convert (const go_zyz ∗zyz, go_rpy ∗rpy)
- go_result gomotion::go_zyx_rvec_convert (const go_zyx ∗zyx, go_rvec ∗r)
- go_result gomotion::go_zyx_quat_convert (const go_zyx ∗zyx, go_quat ∗q)
- go_result gomotion::go_zyx_mat_convert (const go_zyx ∗zyx, go_mat ∗m)
- go_result gomotion::go_zyx_zyz_convert (const go_zyx ∗zyx, go_zyz ∗zyz)
- go_result gomotion::go_zyx_rpy_convert (const go_zyx ∗zyx, go_rpy ∗rpy)
- go_result gomotion::go_xyz_mat_convert (const go_xyz ∗xyz, go_mat ∗m)
- go_result gomotion::go_rpy_rvec_convert (const go_rpy ∗rpy, go_rvec ∗rvec)
- go_result gomotion::go_rpy_quat_convert (const go_rpy ∗rpy, go_quat ∗quat)
- go_result gomotion::go_rpy_mat_convert (const go_rpy ∗rpy, go_mat ∗m)
- go_result gomotion::go_rpy_zyz_convert (const go_rpy ∗rpy, go_zyz ∗zyz)
- go_result gomotion::go_rpy_zyx_convert (const go_rpy ∗rpy, go_zyx ∗zyx)
- go_result gomotion::go_uxz_mat_convert (const go_uxz ∗uxz, go_mat ∗mat)
- go_result gomotion::go_mat_uxz_convert (const go_mat ∗mat, go_uxz ∗uxz)
- go_pose gomotion::go_pose_this (go_real x, go_real y, go_real z, go_real rs, go_real rx, go_real ry, go_real rz)
- go_cart gomotion::go_cart_zero (void)
- go_quat gomotion::go_quat_identity (void)
- go_pose gomotion::go_pose_identity (void)
- go_result gomotion::go_pose_hom_convert (const go_pose ∗p, go_hom ∗h)
- go_result gomotion::go_hom_pose_convert (const go_hom ∗h, go_pose ∗p)
- go_result gomotion::go_cart_rvec_convert (const go_cart ∗cart, go_rvec ∗rvec)
- go_result gomotion::go_rvec_cart_convert (const go_rvec ∗rvec, go_cart ∗cart)
- go_flag gomotion::go_cart_cart_compare (const go_cart ∗v1, const go_cart ∗v2)
- go_result gomotion::go_cart_cart_dot (const go_cart ∗v1, const go_cart ∗v2, go_real ∗d)

- go_result gomotion::go_cart_cart_cross (const go_cart ∗v1, const go_cart ∗v2, go_cart ∗vout)
- go_result gomotion::go_cart_mag (const go_cart ∗v, go_real ∗d)
- go_result gomotion::go_cart_magsq (const go_cart ∗v, go_real ∗d)
- go_flag gomotion::go_cart_cart_par (const go_cart ∗v1, const go_cart ∗v2)
- go_flag gomotion::go_cart_cart_perp (const go_cart ∗v1, const go_cart ∗v2)
- go_result gomotion::go_cart_cart_disp (const go_cart ∗v1, const go_cart ∗v2, go_real ∗d)
- go_result gomotion::go_cart_cart_add (const go_cart ∗v1, const go_cart ∗v2, go_cart ∗vout)
- go_result gomotion::go_cart_cart_sub (const go_cart ∗v1, const go_cart ∗v2, go_cart ∗vout)
- go_result gomotion::go_cart_scale_mult (const go_cart ∗v1, go_real d, go_cart ∗vout)
- go_result gomotion::go_cart_neg (const go_cart ∗v1, go_cart ∗vout)
- go_result gomotion::go_cart_unit (const go_cart ∗v, go_cart ∗vout)
- go_result gomotion::go_cart_is_norm (const go_cart ∗v)
- go_result gomotion::go_cart_cart_rot (const go_cart ∗v1, const go_cart ∗v2, go_quat ∗quat)
- go_result gomotion::go_cart_cart_proj (const go_cart ∗v1, const go_cart ∗v2, go_cart ∗vout)
- go_result gomotion::go_cart_plane_proj (const go_cart ∗v, const go_cart ∗normal, go_cart ∗vout)
- go_result gomotion::go_cart_cart_angle (const go_cart ∗v1, const go_cart ∗v2, go_real ∗a)
- go_result gomotion::go_cart_normal (const go_cart ∗v, go_cart ∗vout)
- go_result gomotion::go_cart_centroid (const go_cart ∗varray, go_integer num, go_cart ∗centroid)
- go_result gomotion::go_cart_centroidize (const go_cart ∗vinarray, go_integer num, go_cart ∗centroid, go_cart ∗voutarray)
- go_complex gomotion::go_complex_add (go_complex z1, go_complex z2)
- go_complex gomotion::go_complex_sub (go_complex z1, go_complex z2)
- go_complex gomotion::go_complex_mult (go_complex z1, go_complex z2)
- go_complex gomotion::go_complex_inv (go_complex z, go_result ∗result)
- go_complex gomotion::go_complex_div (go_complex z1, go_complex z2, go_result ∗result)
- go_complex gomotion::go_complex_sq (go_complex z)
- go_complex gomotion::go_complex_scale (go_complex z, go_real scale)
- go_real gomotion::go_complex_mag (go_complex z)
- go_real gomotion::go_complex_magsq (go_complex z)
- go_real gomotion::go_complex_arg (go_complex z)
- void gomotion::go_complex_sqrt (go_complex z, go_complex ∗z1, go_complex ∗z2)
- void gomotion::go_complex_cbrt (go_complex z, go_complex ∗z1, go_complex ∗z2, go_complex ∗z3)
- go_result gomotion::go_quadratic_solve (const go_quadratic ∗quad, go_complex ∗z1, go_complex ∗z2)
- go_result gomotion::go_cubic_solve (const go_cubic ∗cub, go_complex ∗z1, go_complex ∗z2, go_complex ∗z3)
- go_result gomotion::go_quartic_solve (const go_quartic ∗quart, go_complex ∗z1, go_complex ∗z2, go_complex ∗z3, go_complex ∗z4)
- go_result gomotion::go_tridiag_reduce (go_real ∗∗a, go_integer n, go_real ∗d, go_real ∗e)
- go_result gomotion::go_tridiag_ql (go_real ∗d, go_real ∗e, go_integer n, go_real ∗∗z)
- go_result gomotion::go_cart_cart_pose (const go_cart ∗v1, const go_cart ∗v2, go_cart ∗v1c, go_cart ∗v2c, go_-integer num, go_pose ∗pout)
- go_result gomotion::go_cart_trilaterate (const go_cart ∗c1, const go_cart ∗c2, const go_cart ∗c3, go_real l1, go_real l2, go_real l3, go_cart ∗out1, go_cart ∗out2)
- go_flag gomotion::go_rvec_rvec_compare (const go_rvec ∗r1, const go_rvec ∗r2)
- go_result gomotion::go_rvec_scale_mult (const go_rvec ∗r, go_real s, go_rvec ∗rout)
- go_result gomotion::go_rpy_cart_mult (const go_rpy ∗rpy, const go_cart ∗in, go_cart ∗out)
- go_result gomotion::go_mat_norm (const go_mat ∗mat, go_mat ∗mout)
- go_flag gomotion::go_mat_is_norm (const go_mat ∗m)
- go_result gomotion::go_mat_inv (const go_mat ∗m, go_mat ∗mout)
- go_result gomotion::go_mat_cart_mult (const go_mat ∗m, const go_cart ∗v, go_cart ∗vout)
- go_result gomotion::go_mat_mat_mult (const go_mat ∗m1, const go_mat ∗m2, go_mat ∗mout)
- go_flag gomotion::go_quat_quat_compare (const go_quat ∗q1, const go_quat ∗q2)

- go_result gomotion::go_quat_mag (const go_quat ∗quat, go_real ∗d)
- go_result gomotion::go_quat_unit (const go_quat ∗q1, go_quat ∗qout)
- go_result gomotion::go_quat_norm (const go_quat ∗q1, go_quat ∗qout)
- go_result gomotion::go_quat_inv (const go_quat ∗q1, go_quat ∗qout)
- go_flag gomotion::go_quat_is_norm (const go_quat ∗q1)
- go_result gomotion::go_quat_scale_mult (const go_quat ∗q, go_real s, go_quat ∗qout)
- go_result gomotion::go_quat_quat_mult (const go_quat ∗q1, const go_quat ∗q2, go_quat ∗qout)
- go_result gomotion::go_quat_cart_mult (const go_quat ∗q1, const go_cart ∗v2, go_cart ∗vout)
- go_flag gomotion::go_pose_pose_compare (const go_pose ∗p1, const go_pose ∗p2)
- go_result gomotion::go_pose_inv (const go_pose ∗p1, go_pose ∗p2)
- go_result gomotion::go_pose_cart_mult (const go_pose ∗p1, const go_cart ∗v2, go_cart ∗vout)
- go_result gomotion::go_pose_pose_mult (const go_pose ∗p1, const go_pose ∗p2, go_pose ∗pout)
- go_result gomotion::go_pose_scale_mult (const go_pose ∗p1, go_real s, go_pose ∗pout)
- go_result gomotion::go_pose_pose_interp (go_real t1, const go_pose ∗p1, go_real t2, const go_pose ∗p2, go_-real t3, go_pose ∗p3)
- go_result gomotion::go_hom_inv (const go_hom ∗h1, go_hom ∗h2)
- go_result gomotion::go_hom_hom_mult (const go_hom ∗h1, const go_hom ∗h2, go_hom ∗hout)
- go_result gomotion::go_pose_vel_mult (const go_pose ∗pose, const go_vel ∗vel, go_vel ∗out)
- go_result gomotion::go_line_from_point_direction (const go_cart ∗point, const go_cart ∗direction, go_line ∗line)
- go_result gomotion::go_line_from_points (const go_cart ∗point1, const go_cart ∗point2, go_line ∗line)
- go_result gomotion::go_line_from_planes (const go_plane ∗plane1, const go_plane ∗plane2, go_line ∗line)
- go_flag gomotion::go_line_line_compare (const go_line ∗line1, const go_line ∗line2)
- go_result gomotion::go_line_evaluate (const go_line ∗line, go_real d, go_cart ∗point)
- go_result gomotion::go_point_line_distance (const go_cart ∗point, const go_line ∗line, go_real ∗distance)
- go_result gomotion::go_point_line_proj (const go_cart ∗point, const go_line ∗line, go_cart ∗pout)
- go_result gomotion::go_point_plane_proj (const go_cart ∗point, const go_plane ∗plane, go_cart ∗proj)
- go_result gomotion::go_line_plane_proj (const go_line ∗line, const go_plane ∗plane, go_line ∗proj)
- go_result gomotion::go_plane_from_point_normal (const go_cart ∗point, const go_cart ∗normal, go_plane ∗plane)
- go_result gomotion::go_plane_from_abcd (go_real A, go_real B, go_real C, go_real D, go_plane ∗plane)
- go_result gomotion::go_plane_from_points (const go_cart ∗point1, const go_cart ∗point2, const go_cart ∗point3, go_plane ∗plane)
- go_result gomotion::go_plane_from_point_line (const go_cart ∗point, const go_line ∗line, go_plane ∗plane)
- go_flag gomotion::go_plane_plane_compare (const go_plane ∗plane1, const go_plane ∗plane2)
- go_result gomotion::go_point_plane_distance (const go_cart ∗point, const go_plane ∗plane, go_real ∗distance)
- go_result gomotion::go_plane_evaluate (const go_plane ∗plane, go_real u, go_real v, go_cart ∗point)
- go_result gomotion::go_line_plane_intersect (const go_line ∗line, const go_plane ∗plane, go_cart ∗point, go_real ∗distance)
- go_real gomotion::go_get_singular_epsilon (void)
- go_result gomotion::go_set_singular_epsilon (go_real epsilon)
- go_result gomotion::ludcmp (go_real ∗∗a, go_real ∗scratchrow, go_integer n, go_integer ∗indx, go_real ∗d)
- go_result gomotion::lubksb (go_real ∗∗a, go_integer n, go_integer ∗indx, go_real ∗b)
- go_result gomotion::go_cart_vector_convert (const go_cart ∗c, go_real ∗v)
- go_result gomotion::go_vector_cart_convert (const go_real ∗v, go_cart ∗c)
- go_result gomotion::go_quat_matrix_convert (const go_quat ∗quat, go_matrix ∗matrix)
- go_result gomotion::go_mat_matrix_convert (const go_mat ∗mat, go_matrix ∗matrix)
- go_result gomotion::go_matrix_matrix_add (const go_matrix ∗a, const go_matrix ∗b, go_matrix ∗apb)
- go_result gomotion::go_matrix_matrix_copy (const go_matrix ∗src, go_matrix ∗dst)
- go_result gomotion::go_matrix_matrix_mult (const go_matrix ∗a, const go_matrix ∗b, go_matrix ∗ab)
- go_result gomotion::go_matrix_vector_mult (const go_matrix ∗a, const go_vector ∗v, go_vector ∗axv)
- go_result gomotion::go_matrix_vector_cross (const go_matrix ∗a, const go_vector ∗v, go_matrix ∗axv)

- go_result gomotion::go_matrix_transpose (const go_matrix ∗a, go_matrix ∗at)
- go_result gomotion::go_matrix_inv (const go_matrix ∗m, go_matrix ∗minv)
- go_result gomotion::go_mat3_inv (go_real a[3][3], go_real ainv[3][3])
- go_result gomotion::go_mat3_mat3_mult (go_real a[3][3], go_real b[3][3], go_real axb[3][3])
- go_result gomotion::go_mat3_vec3_mult (go_real a[3][3], go_real v[3], go_real axv[3])
- go_result gomotion::go_mat4_inv (go_real a[4][4], go_real ainv[4][4])
- go_result gomotion::go_mat4_mat4_mult (go_real a[4][4], go_real b[4][4], go_real axb[4][4])
- go_result gomotion::go_mat4_vec4_mult (go_real a[4][4], go_real v[4], go_real axv[4])
- go_result gomotion::go_mat6_inv (go_real a[6][6], go_real ainv[6][6])
- go_result gomotion::go_mat6_transpose (go_real a[6][6], go_real at[6][6])
- go_result gomotion::go_mat6_mat6_mult (go_real a[6][6], go_real b[6][6], go_real axb[6][6])
- go_result gomotion::go_mat6_vec6_mult (go_real a[6][6], go_real v[6], go_real axv[6])
- go_result gomotion::go_dh_hom_convert (const go_dh ∗dh, go_hom ∗h)
- go_result gomotion::go_dh_pose_convert (const go_dh ∗dh, go_pose ∗p)
- go_result gomotion::go_hom_dh_convert (const go_hom ∗h, go_dh ∗dh)
- go_result gomotion::go_pose_dh_convert (const go_pose ∗p, go_dh ∗dh)
- go_result gomotion::go_link_joint_set (const go_link ∗link, go_real joint, go_link ∗linkout)
- go_result gomotion::go_link_pose_build (const go_link ∗link_params, go_integer num, go_pose ∗pose)
- go_result gomotion::go_linear_cos_sin_solve (go_real a, go_real b, go_real ∗th1, go_real ∗th2)

8.8.1 Macro Definition Documentation

8.8.1.1 #define CBRT_IS_POW

8.8.1.2 #define COL_IS_UNIT(*r*) GO_TRAN_CLOSE(go_sq((r).x) + go_sq((r).y) + go_sq((r).z), 1)

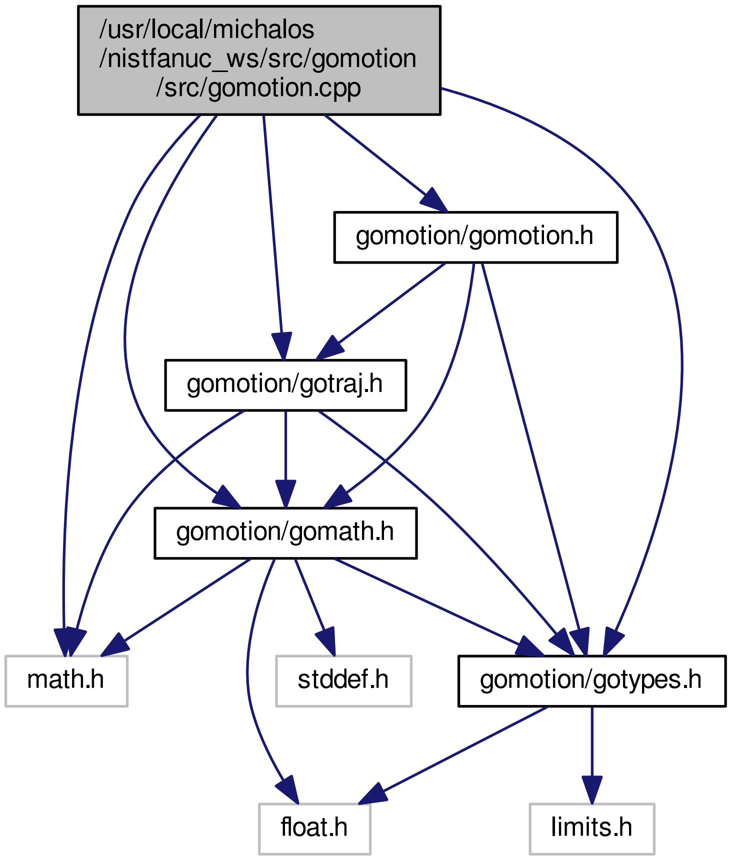
8.8.1.3 #define MAG2(*a, b*) sqrt((a)∗(a)+(b)∗(b))

8.8.1.4 #define SIGN(*a, b*) ((b) >= 0.0 ? fabs(a) : -fabs(a))

8.9 /usr/local/michalos/nistfanuc_ws/src/gomotion/src/gomotion.cpp File Reference

```
#include <math.h>
#include "gomotion/gotypes.h"
#include "gomotion/gomath.h"
#include "gomotion/gotraj.h"
#include "gomotion/gomotion.h"
```

Include dependency graph for gomotion.cpp:



Namespaces

- gomotion

Macros

- #define maxit(a, m) {if ((a) > (m)) (m) = (a);}

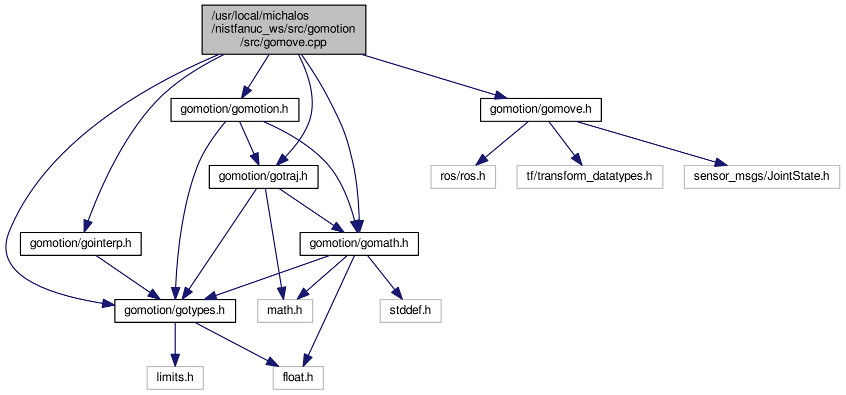
8.9.1 Macro Definition Documentation

8.9.1.1 #define maxit(*a*, *m*) {if ((a) > (m)) (m) = (a);}

8.10 /usr/local/michalos/nistfanuc_ws/src/gomotion/src/gomove.cpp File Reference

```
#include "gomotion/gotypes.h"
#include "gomotion/gointerp.h"
#include "gomotion/gotraj.h"
#include "gomotion/gomotion.h"
#include "gomotion/gomove.h"
#include "gomotion/gomath.h"
```

Include dependency graph for gomove.cpp:



Data Structures

- struct gomotion::go_motion_interface

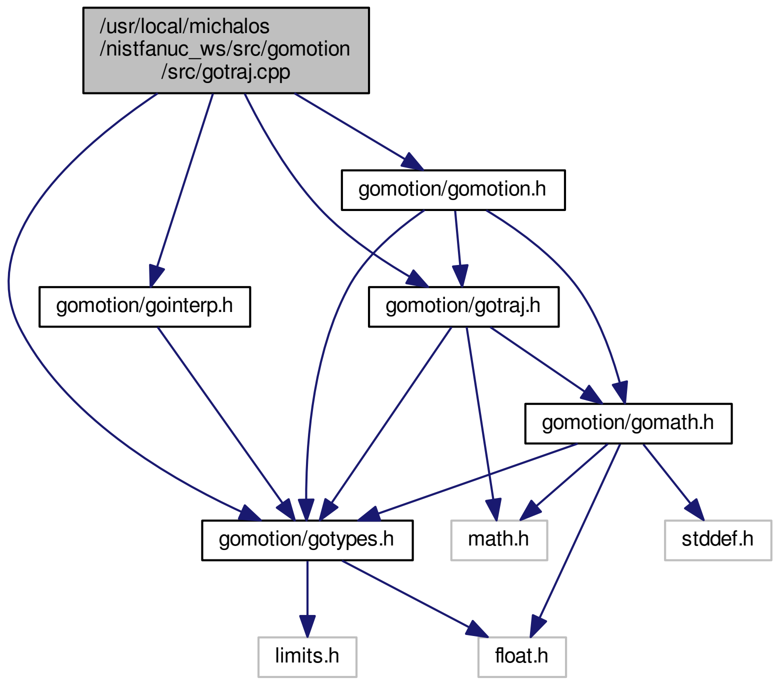
Namespaces

- gomotion

8.11 /usr/local/michalos/nistfanuc_ws/src/gomotion/src/gotraj.cpp File Reference

```
#include "gomotion/gotypes.h"
#include "gomotion/gointerp.h"
#include "gomotion/gotraj.h"
#include "gomotion/gomotion.h"
```

Include dependency graph for gotraj.cpp:



Functions

- int go_init ()
- int go_exit ()

Variables

- int go_result_int = 1
- int go_real_double = 1
- int go_integer_int = 1
- int go_flag_uchar = 1
- go_flag gocode = 0

8.11.1 Function Documentation

8.11.1.1 int go_exit ( )

8.11.1.2 int go_init ( )

8.11.2 Variable Documentation

8.11.2.1 int go_flag_uchar = 1

8.11.2.2 int go_integer_int = 1

8.11.2.3 int go_real_double = 1

8.11.2.4 int go_result_int = 1

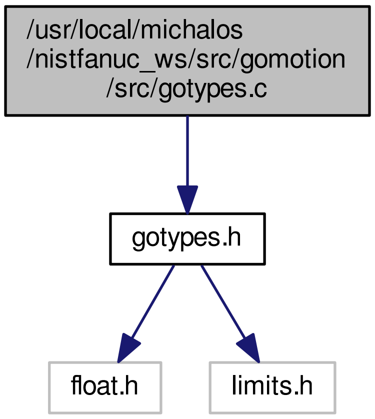
8.11.2.5 go_flag gocode = 0

An ad-hoc flag set by various functions that can be used to indicate various code paths taken.

8.12 /usr/local/michalos/nistfanuc_ws/src/gomotion/src/gotypes.c File Reference

```
#include "gotypes.h"
```

Include dependency graph for gotypes.c:



Variables

- int go_result_int = 1
- int go_real_double = 1
- int go_integer_int = 1
- int go_flag_uchar = 1
- go_flag gocode = 0

8.12.1 Variable Documentation

8.12.1.1 int go_flag_uchar = 1

8.12.1.2 int go_integer_int = 1

8.12.1.3 int go_real_double = 1

8.12.1.4 int go_result_int = 1

8.12.1.5 go_flag gocode = 0

An ad-hoc flag set by various functions that can be used to indicate various code paths taken.

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