THUNDER

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Chapter 1

File Index

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Chapter 2

File Documentation

2.1 include/Geometry/Euler.h File Reference

some description about Euler.h

```
#include <cmath>
#include <gsl/gsl_math.h>
#include "Macro.h"
#include "Typedef.h"
#include "Precision.h"
#include "Random.h"
#include "Functions.h"
```

Functions

void quaternion_mul (dvec4 &dst, const dvec4 &a, const dvec4 &b)

Calculate the product of two quaternions.

dvec4 quaternion_conj (const dvec4 &quat)

Calculate the conjugate quaternion of a quaternion.

• void angle (double &phi, double &theta, const dvec3 &src)

Calculate ϕ and θ given a certain direction ${\bf v}$.

• void angle (double &phi, double &theta, double &psi, const dmat33 &src)

Calculate ϕ , θ and ψ of the rotation represented by the rotation matrix \mathbf{R} .

• void angle (double &phi, double &theta, double &psi, const dvec4 &src)

Calculate $\phi,\,\theta$ and ψ of the rotation represented by the quaternion ${\bf q}.$

• void quaternion (dvec4 &dst, const double phi, const double theta, const double psi)

Calculate the quaternion \mathbf{q} for representing the rotation, given 3 Euler angles ϕ , θ and ψ .

• void quaternion (dvec4 &dst, const double phi, const dvec3 &axis)

Calculate the quaternion \mathbf{q} for representing the rotation, given the rotation axis \mathbf{r} and the rotation angle around this axis ϕ .

void quaternion (dvec4 &dst, const dmat33 &src)

Calculate the quaternion ${\bf q}$ for representing the rotation, given the rotation matrix ${\bf R}$.

void rotate2D (dmat22 &dst, const dvec2 &vec)

Calculate the rotation matrix (2D) \mathbf{R} , which rotates the unit vector $\mathbf{v_0} = \{1, 0\}$ to the given unit vector \mathbf{v} .

void rotate2D (dmat22 &dst, const double phi)

Calculate the rotation matrix (2D) \mathbf{R} , given the rotation angle ϕ .

· void direction (dvec3 &dst, const double phi, const double theta)

Caclulate the unit direction vector \mathbf{v} , given the rotation angle ϕ and θ .

• void rotate3D (dmat33 &dst, const double phi, const double theta, const double psi)

Caclulate the rotation matrix \mathbf{R} , given the rotation angle ϕ , θ and ψ .

void rotate3D (dmat33 &dst, const dvec4 &src)

Calculate the rotation matrix \mathbf{R} , given the unit quaternion \mathbf{q} which represents this rotation.

void rotate3DX (dmat33 &dst, const double phi)

Calculate the rotation matrix ${f R}$ which represents the rotation along X-axis with rotation angle ϕ .

void rotate3DY (dmat33 &dst, const double phi)

Calculate the rotation matrix $\mathbf R$ which represents the rotation along Y-axis with rotation angle ϕ .

void rotate3DZ (dmat33 &dst, const double phi)

Calculate the rotation matrix ${f R}$ which represents the rotation along Z-axis with rotation angle ϕ .

void alignZ (dmat33 &dst, const dvec3 &vec)

Calculate the rotation matrix ${\bf R}$ which aligns a direction vector ${\bf v}$ to Z-axis.

void rotate3D (dmat33 &dst, const double phi, const dvec3 &axis)

Calculate the rotation matrix ${f R}$ which represents the rotation along the axis ${f v}$ with rotation angle ϕ .

void reflect3D (dmat33 &dst, const dvec3 &plane)

Calculate the transformation matrix ${\bf M}$ of reflection against a certian plane, which is represented by its normal vector ${\bf n}$

void swingTwist (dvec4 &swing, dvec4 &twist, const dvec4 &src, const dvec3 &vec)

Calculate the two quaternions $\mathbf{q_s}$ and $\mathbf{q_t}$, which represent swing and twist along axis \mathbf{v} respectively, representing the rotation represented by quaternion \mathbf{q} .

void randRotate2D (dmat22 &rot)

Sample a 2D rotation matrix ${f R}$ from even distribution.

void randRotate3D (dmat33 &rot)

Sample a 3D rotation matrix R from even distribution.

2.1.1 Detailed Description

some description about Euler.h

Details about Euler.h

2.1.2 Function Documentation

2.1.2.1 alignZ()

Calculate the rotation matrix ${\bf R}$ which aligns a direction vector ${\bf v}$ to Z-axis.

Parameters

out	dst	\mathbf{R}
in	vec	v

Calculate ϕ and θ given a certain direction \mathbf{v} .

Parameters

out	phi	ϕ
out	theta	θ
in	src	v

Calculate ϕ , θ and ψ of the rotation represented by the rotation matrix ${\bf R}.$

const dmat33 & src)

Parameters

out	phi	ϕ
out	theta	θ
out	psi	ψ
in	src	\mathbf{R}

2.1.2.4 angle() [3/3]

Calculate $\phi,\,\theta$ and ψ of the rotation represented by the quaternion ${\bf q}.$

const dvec4 & src)

Parameters

out	phi	ϕ
out	theta	θ
out	psi	ψ
in	src	\mathbf{q}

2.1.2.5 direction()

Caclulate the unit direction vector ${\bf v}$, given the rotation angle ϕ and θ .

Parameters

out	dst	v
in	phi	ϕ
in	theta	θ

2.1.2.6 quaternion() [1/3]

Calculate the quaternion ${\bf q}$ for representing the rotation, given 3 Euler angles ϕ, θ and $\psi.$

Parameters

out	dst	\mathbf{q}
in	phi	ϕ
in	theta	θ
in	psi	ψ

2.1.2.7 quaternion() [2/3]

```
void quaternion ( \label{eq:dvec4} \mbox{dvec4 \& } dst,
```

```
const double phi,
const dvec3 & axis )
```

Calculate the quaternion $\bf q$ for representing the rotation, given the rotation axis $\bf r$ and the rotation angle around this axis ϕ .

Parameters

out	dst	q
in	phi	ϕ
in	axis	r

2.1.2.8 quaternion() [3/3]

Calculate the quaternion ${\bf q}$ for representing the rotation, given the rotation matrix ${\bf R}.$

Parameters

out	dst	q
in	src	R

2.1.2.9 quaternion_conj()

Calculate the conjugate quaternion of a quaternion.

Returns

the conjugate quaternion

Parameters

in	quat	a quaternion
----	------	--------------

2.1.2.10 quaternion_mul()

```
void quaternion\_mul (
```

Calculate the product of two quaternions.

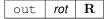
Parameters

out	dst	product, a quaternion
in	а	left multiplier, quaternion
in	b	right multiplier, quaternion

2.1.2.11 randRotate2D()

Sample a 2D rotation matrix \boldsymbol{R} from even distribution.

Parameters

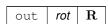


2.1.2.12 randRotate3D()

```
void randRotate3D ( {\tt dmat33 \ \& \ rot \ )}
```

Sample a 3D rotation matrix ${\bf R}$ from even distribution.

Parameters



2.1.2.13 reflect3D()

```
void reflect3D ( \label{eq:dmat33 \& dst,}  const dvec3 & plane )
```

Calculate the transformation matrix ${\bf M}$ of reflection against a certian plane, which is represented by its normal vector ${\bf n}$.

Parameters

out	dst	M
in	plane	n

2.1.2.14 rotate2D() [1/2]

Calculate the rotation matrix (2D) ${f R}$, which rotates the unit vector ${f v_0}=\{1,0\}$ to the given unit vector ${f v}$.

Parameters

out	dst	R
in	vec	\mathbf{v}

2.1.2.15 rotate2D() [2/2]

Calculate the rotation matrix (2D) \mathbf{R} , given the rotation angle ϕ .

Parameters

out	dst	\mathbf{R}
in	phi	ϕ

2.1.2.16 rotate3D() [1/3]

Caclulate the rotation matrix ${\bf R}$, given the rotation angle ϕ , θ and ψ .

Parameters

out	dst	\mathbf{R}
in	phi	ϕ
in	theta	θ
in	psi	ψ

2.1.2.17 rotate3D() [2/3]

Calculate the rotation matrix $\boldsymbol{R},$ given the unit quaternion \boldsymbol{q} which represents this rotation.

Parameters

out	dst	\mathbf{R}
in	src	\mathbf{q}

2.1.2.18 rotate3D() [3/3]

Calculate the rotation matrix ${\bf R}$ which represents the rotation along the axis ${\bf v}$ with rotation angle ϕ .

Parameters

out	dst	R
in	phi	ϕ
in	axis	v

2.1.2.19 rotate3DX()

```
void rotate3DX ( \label{eq:dmat33 \& dst,}  const double phi )
```

Calculate the rotation matrix ${f R}$ which represents the rotation along X-axis with rotation angle ϕ .

Parameters

out	dst	R
in	phi	ϕ

2.1.2.20 rotate3DY()

```
void rotate3DY ( \label{eq:dmat33 \& dst,}  const double phi )
```

Calculate the rotation matrix ${f R}$ which represents the rotation along Y-axis with rotation angle ϕ .

Parameters

out	dst	\mathbf{R}
in	phi	ϕ

2.1.2.21 rotate3DZ()

```
void rotate3DZ ( {\tt dmat33 \& \textit{dst,}} const double phi )
```

Calculate the rotation matrix ${f R}$ which represents the rotation along Z-axis with rotation angle ϕ .

Parameters

out	dst	R
in	phi	ϕ

2.1.2.22 swingTwist()

Calculate the two quaternions $\mathbf{q_s}$ and $\mathbf{q_t}$, which represent swing and twist along axis \mathbf{v} respectively, representing the rotation represented by quaternion \mathbf{q} .

Parameters

out	swing	$\mathbf{q_s}$
out	twist	$\mathbf{q_t}$
in	src	\mathbf{q}
in	vec	v

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