User Manual 3.3 Guidance commands

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Introduction

Scope

A guidance profile is an attitude law providing the computation of an instantaneous attitude without any reference to the satellite orbit, nor to its attitude laws sequence. The purpose of this section is to present the guidance profiles available through the Patrius library.

Javadoc

The guidance models and classes are available in the guidance package in the Patrius library.

Library	Javadoc
Patrius	Package fr.cnes.sirius.patrius.guidance

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Package Overview

The following diagram shows the guidance package conception:

Features Description

Harmonic guidance profiles

The functions representing the angular velocity of the satellite and the quaternion (or the Euler angles) expressing its orientation can be represented by an harmonic profile. The harmonic profile is a Fourier decomposition of a periodic function:

[math] S_n\left(f(x)\right) = a_0(f) + \sum_{k=1}^n\left(a_k(f)\cos\left(k x {2\pi\over T}\right) + b_k(f)\sin\left(k x {2\pi\over T}\right)\right) [/math]

The period T is generally computed knowing the nodes crossing periods.

The Fourier coefficients (n > 0) of [math]f[/math] (the angular velocity / quaternions / Euler angles function) are given by :

[math] a_0(f) = {1\over T}\int_{-T/2}^{T/2} \! f(t) \, \mathrm{d}t [/math]

[math] b_0(f) = 0 [/math]

[math] a_n(f) = {2\over T}\int_{-T/2}^{T/2} \! f(t) \cos\left(n t {2\pi\over T}\right) \, \mathrm{d}t [/math]

[math] b_n(f) = {2\over T}\int_{-T/2}^{T/2} \! f(t) \sin\left(n t {2\pi\over T}\right) \, \mathrm{d}t [/math]

Polynomial guidance profiles

A polynomial guidance profile is generally composed by several segments (a segment corresponds to a time interval). Each segment contains the coefficients for the computation of a polynomial law representing the quaternion (or the Euler angles), or the angular velocity of the satellite; this polynomial law is valid only inside the time interval associated to the segment.

For a quaternion, the polynomials are defined as :

[math]Qc_k(t) = \begin{pmatrix} \displaystyle\sum_{i=0}^n {a_0}_k^i \left(t-t_k \over {\Delta t} \right) \\ \displaystyle\sum_{i=0}^n {a_1}_k^i \left(t-t_k \over {\Delta t} \right) \\ \displaystyle\sum_{i=0}^n {a_2}_k^i \left(t-t_k \over {\Delta t} \right) \\ \displaystyle\sum_{i=0}^n {a_3}_k^i \left(t-t_k \over {\Delta t} \right) \end{pmatrix}[/math]

And for the angular velocity :

[math]\Omega c_k(t) = \begin{pmatrix} \displaystyle\sum_{i=0}^n {a_x}_k^i \left(\frac{t-t_k}{\Delta t} \right) \\ \displaystyle\sum_{i=0}^n {a_y}_k^i \left(\frac{t-t_k}{\Delta t} \right) \\ \displaystyle\sum_{i=0}^n {a_z}_k^i \left(\frac{t-t_k}{\Delta t} \right) \end{pmatrix}[/math]

Build an harmonic guidance profile from an attitude law

Given :

- an AttitudeLawLeg,
- a PVCoordinatesProvider,
- a Frame,
- a reference date `tref`,
- a spin function period,
- a spin decomposition order,
- an integration type,
- an integration step,

one can build an angular velocities guidance profile using the code snippet below :

```
profile =
GuidanceProfileBuilder.computeAngularVelocitiesHarmonicProfile(attitude,
prop, gcrf, tref,
                    period, order, IntegrationType.WILCOX_4,
KinematicsToolkit.DEFAULT_8HZ);
```

Getting Started

TBD

Contents

Interfaces

None.

Classes

Class	Summary	Javadoc
KinematicsToolkit	This class contains static methods performing kinematics operations.	...
GuidanceProfile	Abstract class representing a guidance profile.	...
GuidanceProfileBuilder	This class creates guidance profiles from an attitude law.	...
QuaternionHarmonicProfile	Object representing a quaternion guidance profile, calculated with Fourier series.	...
QuaternionPolynomialProfile	Object representing a quaternion guidance profile, calculated with polynomials.	...
QuaternionPolynomialSegment	Object representing a quaternion polynomial guidance profile on a segment.	...
AngularVelocitiesHarmonicProfile	Represents an angular velocities guidance profile, calculated with Fourier series.	...
AngularVelocitiesPolynomialProfile	Represents an angular velocities guidance profile, calculated with polynomial functions.	...
AngularVelocitiesPolynomialSegment	Object representing an angular velocity polynomial guidance profile on a segment.	...
Vector3DPolynomialSegment	Object representing an angular velociy polynomial guidance profile on a segment.	...

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