User Manual 4.8 Attitude leg

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Introduction

Scope

The purpose of this chapter is to describe the current Patrius attitude legs.

An attitude leg is a time-bounded attitude law. Generalities on attitude laws can be found [ATT_ALW_Home here].

Javadoc

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Links

Orekit attitudes : Orekit Attitudes architecture description

Useful Documents

None as of now.

Package Overview

The attitude leg `AttitudeLeg` interface inherits the `AttitudeProvider` interface. Its place in the global Attitude design can be found [ATT_ALW_PkgOverview here]. It also inherits the general `Leg` interface presented below.

Features Description

Generalities: the Leg and the LegsSequence interfaces

Attitude legs inherit the interface `AttitudeLeg`. In addition to `AttitudeProvider` services, they inherit the methods of the `Leg` interface which means they are time-bounded attitude providers.

The `Leg` interface is a generic interface for time-bounded timestamped data. It has only one method `getTimeInterval()` (as well as method allowing to retrieve start and end of interval). This `Leg` interface allows to define an `AttitudeLeg`.

In order to define an attitude sequence `StrictAttitudeLegsSequence`, another generic interface is available: the `LegsSequence` interface. This interface defines a sequence of `Leg` and provides methods to manipulate a collection of timestamped legs similarly to the `Collection` interface (methods `first()`, `next()`, etc.). A implementation of `LegsSequence` is available:

`StrictLegsSequence`. This class handles a sequence of legs which are strictly ordered (not overlapping is allowed), legs are ordered by their starting date. The sequence of attitude legs `StrictAttitudeLegsSequence` inherits the `StrictLegsSequence` by considering legs as `AttitudeLegs`.

Note: the `Leg`and `LegsSequence`interfaces are purely generic and therefore can be used for any other time-bounded data.

Available attitude leg

Attitude legs sequence

An attitude legs sequence is a container for several attitude legs, contiguous for their time intervals, in such a way that the attitude legs sequence can be processed like a single attitude leg by the propagator.

The attitude legs sequence is the equivalent of the [ATT_ALW_Home#HAttitudessequence Attitudes sequence], using attitude legs (`AttitudeLeg` instances) rather than attitude laws (`AttitudeLaw` instances). The switching from one attitude leg to another is based on the time interval of validity of the two legs.

TabulatedAttitude

`TabulatedAttitude` is an implementation of `AttitudeLeg`. It represents a tabulated attitude leg.

In order to interpolate the attitude at a date, the user must specify a list of **ordered** attitudes, and can specify a number of points used by Hermite interpolation. If not specified, the number of points used by Hermite interpolation is set to a default number (currently 2).

```
final List<Attitude> attList = new ArrayList<Attitude>();
attList.add(attitude0);
attList.add(attitude1);
final int nbrInterpPoints = 2;
final TabulatedAttitude attLeg = new TabulatedAttitude(attList,
nbrInterpPoints);
```

It is possible to get the non-interpolated ordered attitudes :

```
final List<Attitude> attitudes = attLeg.getAttitudes();
```

Once the tabulated is defined, the computation can be performed on any orbital state using `getAttitude()` method:

```
Attitude attitude = attLeg.getAttitude(orbit, date,
FramesFactory.getEME2000());
```

RelativeTabulatedAttitudeLeg

`RelativeTabulatedAttitudeLeg` is an implementation of `AttitudeLeg`. An instance of

`RelativeTabulatedAttitudeLeg` can be created with a `List<Pair<Double, Rotation>>` or with a `List<Pair<Double, AngularCoordinates>>`. Each `Rotation` (or `AngularCoordinates`) is associated with a `double` representing its time ellapsed in seconds since the reference date. Here is an example of a creation of an instance of `RelativeTabulatedAttitudeLeg` :

```
// date and frame
AbsoluteDate refDate = new AbsoluteDate(2008, 1, 1,
TimeScalesFactory.getTAI());
Frame frame = FramesFactory.getGCRF();
double timeEllapsedSinceRefDate = 1.0;

// List of AR
List<Pair<Double, AngularCoordinates>> listAr = new ArrayList<Pair<Double,
AngularCoordinates>>();
final AngularCoordinates ar = new AngularCoordinates(
                new Rotation(false, 0.48, 0.64, 0.36, 0.48), Vector3D.PLUS_I,
Vector3D.PLUS_J);
listAr.add(new Pair<Double, AngularCoordinates>(timeEllapsedSinceRefDate,
ar));

// create RelativeTabulatedAttitudeLeg
final RelativeTabulatedAttitudeLeg relativeTabulatedAttitudeLeg =
                new RelativeTabulatedAttitudeLeg(refDate, frame, listAr);
```

Getting Started

Building an attitude legs sequence

The attitude legs sequence was designed as a simple container, it performs only a few coherence checks on its inner attitude laws. Here's how an attitude sequence is built.

- An attitude legs sequence is created empty, associated to a single `PVCoordinatesProvider` instance.
- The sequence is mutable, attitude laws can be added to it one by one.
- Each attitude law is identified by a code.
- The sequence has a validity time interval, which is the grouping of the validity time intervals of all contained laws.
- The time interval of a newly added law must be contiguous to the grouped time interval of the already added laws. Otherwise an PatriusException is thrown.
- As soon as the sequence contains at least one law, methods of the `AttitudeLeg` interface can be called on the attitude sequence. The attitude sequence forwards the request to the appropriate attitude leg (according to the asking date), but replaces the `PVCoordinatesProvider` attribute of the call with the inner `PVCoordinatesProvider` instance.

AttitudeLawLeg and AttitudeLegsSequence : Code sample

```
final BodyCenterPointing earthCenterAttitudeLaw = new
BodyCenterPointing(itrf);
final AttitudeLeg law1 = new AttitudeLawLeg(earthCenterAttitudeLaw, date1,
date2);
final AttitudeLeg law2 = ... ;
final AttitudeLeg law3 = ... ;

PVCoordinatesProvider pvProvider = new CartesianOrbit(pvCoordinates, gcrf,
date1, mu);
final StrictAttitudeLegsSequence sequence = new
StrictAttitudeLegsSequence(pvProvider);
sequence.add(law1);
sequence.add(law2);
sequence.add(law3);

// Call to getAttitude on the sequence
final Attitude attitude = sequence.getAttitude(pvProvider, date, itrf);
```

Contents

Interfaces

Interface	Summary	Javadoc
Leg	This interface is a generic interface for any king of time-bounded data.	...
LegsSequence	This interface is a generic interface for any sequence of legs.	...
AttitudeLeg	This interface extends the AttitudeProvider interface and adds the time interval of validity notion to the attitude laws.	...

Classes

Class	Summary	Javadoc
StrictLegsSequence	This class is a generic class for handling any sequence of legs.	...
AttitudeLawLeg	Object representing an attitude law for spacecraft attitude field purposes.	...
TabulatedAttitude	Object representing a tabulated attitude leg : the attitude at a date is interpolated from a list of known ones.	...
StrictAttitudeLegsSequence	Object representing a sequence of attitude legs.	...
RelativeTabulatedAttitudeLeg	This class implements a tabulated attitude leg with relative dates.	...

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