ReferenceFrameModel

5.3

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6.3 RefFrames

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- file class_declarations.hh

  Forward declarations of classes defined in ref_frame.hh.
- file ref_frame.hh

  Define the class RefFrame.
- file ref_frame_inline.hh

  Define inline methods for the RefFrame class.
- file ref_frame_interface.hh

  Define the class RefFrameOwner, which identifies an object as an "owner" of a reference frame.
- file ref_frame_items.hh

  Define the class RefFrameItems, which identifies the aspects of a reference frame's state that have been set.
- file ref_frame_items_inline.hh

  Define inline functions for the RefFrameItems::Items.
- file ref_frame_links.hh

  Define the class RefFrameLinks, the class that encapsulates the links between reference frames.
- file ref_frame_manager.hh

  Define the RefFrameManager class, which manages the reference frames in a JEOD-based simulation.
- file ref_frame_messages.hh

  Define the class RefFrameMessages, the class that specifies the message IDs used in the reference frames model.
- file ref_frame_state.hh

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- file subscription.hh

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- file tree_links.hh

  Define the template class TreeLinks, the class that encapsulates the parent/ child links between objects.
- file tree_links_iterator.hh

  Define the template TreeLinksRange and related templates, which are used to iterate over trees.
- file ref_frame.cc

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- jeod

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Chapter 7

Namespace Documentation

7.1 jeod Namespace Reference

Namespace jeod.

Data Structures

- class ActivateInterface

  A class that inherits from the ActivateInterface class must provide activate and deactivate methods.
- class BaseRefFrameManager

  The RefFrameManager class manages the reference frames in a simulation.
- struct JeodLinksIterators

  Class template that defines member types ForwardIterator and ReverseIterator for walking over a std::vector of pointers to Links objects.
- struct JeodLinksIterators< const Links >

  Partial specialization of JeodLinksIterators for const Links types.
- class RefFrame

  Describe a frame of reference and define operations on reference frames.
- class RefFrameItems

  Identify which aspects of a reference frame's state have been set.
- class RefFrameLinks

  Encapsulates the links between reference frames.
- class RefFrameManager

  The RefFrameManager class manages the reference frames in a simulation.
- class RefFrameMessages

  Declares messages associated with the reference frames model.
- class RefFrameOwner

  Identify an object as an "owner" of a reference frame.
- class RefFrameRot

  Represent the rotational aspects of a reference frame's state.
- class RefFrameState

  Represent a reference frame's state.
- class RefFrameTrans

  Represent the translational aspects of a reference frame's state.
- class SubscribeInterface

A class that inherits from the SubscribeInterface class must provide subscribe and unsubscribe methods.

- class Subscription

  A Subscription object provides two approaches of marking something as being active or inactive: The activate and deactivate methods versus the subscribe and unsubscribe methods.

- class TreeLinks

  Encapsulates links (parent, children, siblings) between objects, in the form of a tree.

- class TreeLinksAscendRange

  A TreeLinksAscendRange walks up a Links object's path_to_node_ data member, starting at the start node and ending just before the end node.

- class TreeLinksChildIterator
- class TreeLinksChildrenRange

  A TreeLinksChildrenRange walks over a Links object's children_.

- class TreeLinksDescentIterator
- class TreeLinksDescentRange

  A TreeLinksDescentRange walks down a Links object's path_to_node_ data member, starting at the start node and ending just before the end node.

- class TreeLinksIterator
- class TreeLinksParentIterator
- class TreeLinksRange

  Base class template for all tree links range types.

7.1.1 Detailed Description

Namespace jeod.

Chapter 8

Data Structure Documentation

8.1 jeod::ActivateInterface Class Reference

A class that inherits from the ActivateInterface class must provide activate and deactivate methods.

`#include <subscription.hh>`

Public Member Functions

- ActivateInterface ()=default
- virtual ~ActivateInterface ()=default
- virtual void activate ()=0

  Mark the object as active.
- virtual void deactivate ()=0

  Mark the object as inactive.

8.1.1 Detailed Description

A class that inherits from the ActivateInterface class must provide activate and deactivate methods.

Definition at line 77 of file subscription.hh.

8.1.2 Constructor & Destructor Documentation

8.1.2.1 ActivateInterface()

`jeod::ActivateInterface::ActivateInterface ( )  [default]`

8.1.2.2 ~ActivateInterface()

```
virtual jeod::ActivateInterface::~ActivateInterface ( )  [virtual], [default]
```

8.1.3 Member Function Documentation

8.1.3.1 activate()

```
virtual void jeod::ActivateInterface::activate ( )  [pure virtual]
```

Mark the object as active.

8.1.3.2 deactivate()

```
virtual void jeod::ActivateInterface::deactivate ( )  [pure virtual]
```

Mark the object as inactive.

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

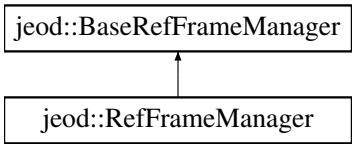
- subscription.hh

8.2 jeod::BaseRefFrameManager Class Reference

The RefFrameManager class manages the reference frames in a simulation.

```
#include <base_ref_frame_manager.hh>
```

Inheritance diagram for jeod::BaseRefFrameManager:



Public Member Functions

- virtual ~BaseRefFrameManager ()=default

  Destructor.
- virtual void add_ref_frame (RefFrame &ref_frame)=0

  Add a reference frame to the list of such.
- virtual void remove_ref_frame (RefFrame &ref_frame)=0

  Remove a reference frame from the list of such.
- virtual RefFrame * find_ref_frame (const std::string &name) const =0

  Find a reference frame.
- virtual RefFrame * find_ref_frame (const std::string &prefix, const std::string &suffix) const =0

  Find a reference frame.
- virtual void check_ref_frame_ownership () const =0

  Check whether each reference frame has an owner.
- virtual void reset_tree_root_node ()=0

  Reset the root node in anticipation of rebuilding the entire tree.
- virtual void add_frame_to_tree (RefFrame &ref_frame, RefFrame *parent)=0

  Add a reference frame to the reference frame tree.
- virtual void subscribe_to_frame (const std::string &frame_name)=0

  Add a subscription to a reference frame.
- virtual void subscribe_to_frame (RefFrame &frame)=0

  Add a subscription to a reference frame.
- virtual void unsubscribe_to_frame (const std::string &frame_name)=0

  Remove a subscription from a reference frame.
- virtual void unsubscribe_to_frame (RefFrame &frame)=0

  Remove a subscription from a reference frame.
- virtual bool frame_is_subscribed (const std::string &frame_name)=0

  Check whether a reference frame has subscriptions.
- virtual bool frame_is_subscribed (RefFrame &frame)=0

  Check whether a reference frame has subscriptions.

Friends

- class InputProcessor
- void init_attrjeod__BaseRefFrameManager ()

8.2.1 Detailed Description

The RefFrameManager class manages the reference frames in a simulation.

This class defines the external interfaces to that class.

Definition at line 78 of file base_ref_frame_manager.hh.

8.2.2 Constructor & Destructor Documentation

8.2.2.1 ~BaseRefFrameManager()

```
virtual jeod::BaseRefFrameManager::~BaseRefFrameManager ( )  [virtual], [default]
```

Destructor.

8.2.3 Member Function Documentation

8.2.3.1 add_frame_to_tree()

```
virtual void jeod::BaseRefFrameManager::add_frame_to_tree (
            RefFrame & ref_frame,
            RefFrame * parent )  [pure virtual]
```

Add a reference frame to the reference frame tree.

Parameters

ref_frame	Frame to be added.
parent	Parent of the frame.

Implemented in jeod::RefFrameManager.

8.2.3.2 add_ref_frame()

```
virtual void jeod::BaseRefFrameManager::add_ref_frame (
            RefFrame & ref_frame )  [pure virtual]
```

Add a reference frame to the list of such.

Parameters

ref_frame	Frame to be added.

Implemented in jeod::RefFrameManager.

8.2.3.3 check_ref_frame_ownership()

```
virtual void jeod::BaseRefFrameManager::check_ref_frame_ownership ( ) const  [pure virtual]
```

Check whether each reference frame has an owner.

Implemented in jeod::RefFrameManager.

8.2.3.4 find_ref_frame() [1/2]

```
virtual RefFrame* jeod::BaseRefFrameManager::find_ref_frame (
            const std::string & name ) const  [pure virtual]
```

Find a reference frame.

Parameters

name	Frame to be found.

Returns

Found reference frame.

Implemented in jeod::RefFrameManager.

8.2.3.5 find_ref_frame() [2/2]

```
virtual RefFrame* jeod::BaseRefFrameManager::find_ref_frame (
            const std::string & prefix,
            const std::string & suffix ) const  [pure virtual]
```

Find a reference frame.

Parameters

prefix	Prefix of frame to be found.
suffix	Suffix of frame to be found.

Returns

Found reference frame.

Implemented in jeod::RefFrameManager.

8.2.3.6 frame_is_subscribed() [1/2]

```
virtual bool jeod::BaseRefFrameManager::frame_is_subscribed (
            const std::string & frame_name )  [pure virtual]
```

Check whether a reference frame has subscriptions.

Parameters

frame_name	Frame to be checked.

Returns

True if frame has subscriptions, false otherwise.

Implemented in jeod::RefFrameManager.

8.2.3.7 frame_is_subscribed() [2/2]

```
virtual bool jeod::BaseRefFrameManager::frame_is_subscribed (
            RefFrame & frame )  [pure virtual]
```

Check whether a reference frame has subscriptions.

Parameters

frame	Frame to be checked.

Returns

True if frame has subscriptions, false otherwise.

Implemented in jeod::RefFrameManager.

8.2.3.8 remove_ref_frame()

```
virtual void jeod::BaseRefFrameManager::remove_ref_frame (
            RefFrame & ref_frame )  [pure virtual]
```

Remove a reference frame from the list of such.

Parameters

ref_frame	Frame to be removed.

Implemented in jeod::RefFrameManager.

8.2.3.9 reset_tree_root_node()

```
virtual void jeod::BaseRefFrameManager::reset_tree_root_node ( )  [pure virtual]
```

Reset the root node in anticipation of rebuilding the entire tree.

Implemented in jeod::RefFrameManager.

8.2.3.10 subscribe_to_frame() [1/2]

```
virtual void jeod::BaseRefFrameManager::subscribe_to_frame (
            const std::string & frame_name )  [pure virtual]
```

Add a subscription to a reference frame.

Parameters

frame_name	Frame to which subscription is to be issued.

Implemented in jeod::RefFrameManager.

8.2.3.11 subscribe_to_frame() [2/2]

```
virtual void jeod::BaseRefFrameManager::subscribe_to_frame (
            RefFrame & frame )  [pure virtual]
```

Add a subscription to a reference frame.

Parameters

frame	Frame to which subscription is to be issued.

Implemented in jeod::RefFrameManager.

8.2.3.12 unsubscribe_to_frame() [1/2]

```
virtual void jeod::BaseRefFrameManager::unsubscribe_to_frame (
            const std::string & frame_name )  [pure virtual]
```

Remove a subscription from a reference frame.

Parameters

frame_name	Frame from which subscription is to be removed.

Implemented in jeod::RefFrameManager.

8.2.3.13 unsubscribe_to_frame() [2/2]

```
virtual void jeod::BaseRefFrameManager::unsubscribe_to_frame (
            RefFrame & frame )  [pure virtual]
```

Remove a subscription from a reference frame.

Parameters

frame	Frame from which subscription is to be removed.

Implemented in jeod::RefFrameManager.

8.2.4 Friends And Related Function Documentation

8.2.4.1 init_attrjeod__BaseRefFrameManager

```
void init_attrjeod__BaseRefFrameManager ( )  [friend]
```

8.2.4.2 InputProcessor

```
friend class InputProcessor  [friend]
```

Definition at line 80 of file base_ref_frame_manager.hh.

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

- base_ref_frame_manager.hh

8.3 jeod::JeodLinksIterators< Links > Struct Template Reference

Class template that defines member types ForwardIterator and ReverseIterator for walking over a std::vector of pointers to Links objects.

```
#include <tree_links_iterator.hh>
```

Public Types

- using ForwardIterator = typename std::vector< Links * >::iterator
- using ReverseIterator = typename std::vector< Links * >::reverse_iterator

8.3.1 Detailed Description

template<class Links>
struct jeod::JeodLinksIterators< Links >

Class template that defines member types ForwardIterator and ReverseIterator for walking over a std::vector of pointers to Links objects.

This primary template definition is for a non-const Links type.

Template Parameters

Links	Link object type.

Definition at line 90 of file tree_links_iterator.hh.

8.3.2 Member Typedef Documentation

8.3.2.1 ForwardIterator

```
template<class Links>
using jeod::JeodLinksIterators< Links >::ForwardIterator = typename std::vector<Links *>↩
::iterator
```

Definition at line 92 of file tree_links_iterator.hh.

8.3.2.2 ReverseIterator

```
template<class Links>
using jeod::JeodLinksIterators< Links >::ReverseIterator = typename std::vector<Links *>↩
::reverse_iterator
```

Definition at line 93 of file tree_links_iterator.hh.

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

- tree_links_iterator.hh

8.4 jeod::JeodLinksIterators< const Links > Struct Template Reference

Partial specialization of JeodLinksIterators for const Links types.

```
#include <tree_links_iterator.hh>
```

Public Types

- using ForwardIterator = typename std::vector< Links * >::const_iterator
- using ReverseIterator = typename std::vector< Links * >::const_reverse_iterator

8.4.1 Detailed Description

template<class Links>
struct jeod::JeodLinksIterators< const Links >

Partial specialization of JeodLinksIterators for const Links types.

Like the primary definition, this specialization defines member types ForwardIterator and ReverseIterator, but this are now const iterators.

Template Parameters

Links	Link object type.

Definition at line 102 of file tree_links_iterator.hh.

8.4.2 Member Typedef Documentation

8.4.2.1 ForwardIterator

```
template<class Links >
using jeod::JeodLinksIterators< const Links >::ForwardIterator = typename std::vector<Links
*>::const_iterator
```

Definition at line 104 of file tree_links_iterator.hh.

8.4.2.2 ReverseIterator

```
template<class Links >
using jeod::JeodLinksIterators< const Links >::ReverseIterator = typename std::vector<Links
*>::const_reverse_iterator
```

Definition at line 105 of file tree_links_iterator.hh.

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

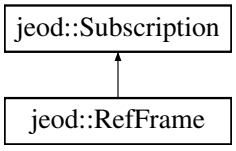
- tree_links_iterator.hh

8.5 jeod::RefFrame Class Reference

Describe a frame of reference and define operations on reference frames.

```
#include <ref_frame.hh>
```

Inheritance diagram for jeod::RefFrame:



Public Member Functions

- RefFrame ()

  Construct a RefFrame object.
- ~RefFrame () override

  Destroy a RefFrame object.
- RefFrame (const RefFrame &frame)=delete
- RefFrame & operator= (const RefFrame &frame)=delete
- template<typename... Type>
  void set_name (const std::string &nameIn, Type... namesIn)
- void set_name (const std::string &nameIn)
- virtual std::string get_name () const

  Return the name.
- virtual void set_timestamp (double time)

  Set the update time of this frame.
- virtual double timestamp () const

  Return the update time of this frame.
- virtual void set_owner (RefFrameOwner *new_owner)

  Set the owner of this frame.
- virtual RefFrameOwner * get_owner () const

  Return the owner of this frame.
- void set_active_status (bool value) override

  Augment Subscription::set_active_status by telling the frame owner that the active/inactive state of this frame has changed.
- const RefFrame * get_parent () const

  Return the parent of this frame.
- const RefFrame * get_root () const

  Return the root of this frame's tree.
- virtual void make_root ()

  Make this frame a root frame.
- virtual void add_child (RefFrame &frame)

  Add a child frame to this frame.
- virtual void remove_from_parent ()

  Remove this node as a child of its parent node.
- bool is_progeny_of (const RefFrame &frame) const

  Return true if this frame is a progeny of the provided frame, false if not.
- virtual void transplant_node (RefFrame &new_parent)

  Move a node to a different place in the tree, keeping the state with respect to the root frame constant.
- virtual void reset_parent (RefFrame &new_parent)

  Reparent a node, without updating state.
- virtual void compute_relative_state (const RefFrame &wrt_frame, RefFrameState &rel_state) const

  *Compute the complete state of the invoking reference frame (*this) with respect to the supplied wrt_frame reference frame.*
- virtual void compute_relative_state (const RefFrame &wrt_frame, bool reverse_sense, RefFrameState &rel↩
  _state) const

  *Compute the complete state of the invoking reference frame (*this) with respect to the supplied wrt_frame reference frame.*
- virtual void compute_state_wrt_pred (const RefFrame &wrt_frame, RefFrameState &rel_state) const

  Compute the complete state of the invoking reference frame with respect to the supplied reference frame, which must be a predecessor of the invoking frame.
- virtual void compute_state_wrt_pred (unsigned int wrt_frame_index, RefFrameState &rel_state) const

Compute the complete state of the invoking reference frame with respect to the supplied reference frame, which must be a predecessor of the invoking frame.

- virtual void compute_pred_rel_state (const RefFrame &wrt_frame, RefFrameState &rel_state) const

  Compute the complete state of the invoking reference frame with respect to the supplied reference frame, which must be a predecessor of the invoking frame.

- virtual void compute_pred_rel_state (unsigned int wrt_frame_index, RefFrameState &rel_state) const

  Compute the complete state of the supplied reference frame wrt the invoking reference frame.

- virtual void compute_position_from (const RefFrame &in_frame, double rel_pos[3]) const

  Compute the relative position vector from the origin of the supplied reference frame to the origin of this reference frame, expressed in the coordinates of the supplied frame.

- const RefFrame * find_last_common_node (const RefFrame &frame) const

  Each reference frame has a path from the root of the reference frame tree to the frame in question.

Data Fields

- RefFrameState state

  The translational and rotational state of the reference frame with respect to its parent.

Protected Member Functions

- int find_last_common_index (const RefFrame &frame) const

  Each reference frame has a path from the root of the reference frame tree to the frame in question.

Protected Attributes

- std::string name

  The identifier for this reference frame.

- RefFrameOwner * owner {}

  The object that "owns" this frame.

- RefFrameLinks links

  Specifies the parent/child/sibling linkages between frames.

- double update_time {}

  The time that the frame was lasted updated, dynamic time seconds.

Friends

- class InputProcessor
- class RefFrameLinks
- void init_attrjeod__RefFrame ()

Additional Inherited Members

8.5.1 Detailed Description

Describe a frame of reference and define operations on reference frames.

A JEOD reference frame

- Is characterized by an origin and and a set of three orthogonal axes.
- Provides a mechanism for specifying the translational and rotational states of an object in space (particularly, Cartesian three space).
- Is itself an object whose translational and rotational states can be specified/determined in terms of some other reference frame.
- Is a node in a rooted tree of reference frames, each of which has some specific state with respect to another node in the tree.
- Can be active (or inactive). An active frame supposedly will have a (fairly) current state. All bets are off if the frame is inactive.
- Can have subscribers, which are external entities that for some reason need the frame to be active.

Reference frames are one of the key concepts that define JEOD 2.0.

Definition at line 98 of file ref_frame.hh.

8.5.2 Constructor & Destructor Documentation

8.5.2.1 RefFrame() [1/2]

```
jeod::RefFrame::RefFrame ( )
```

Construct a RefFrame object.

Definition at line 47 of file ref_frame.cc.

References jeod::Subscription::set_subscription_mode(), and jeod::Subscription::Subscribe.

8.5.2.2 ~RefFrame()

```
jeod::RefFrame::~RefFrame ( )  [override]
```

Destroy a RefFrame object.

Definition at line 57 of file ref_frame.cc.

References jeod::TreeLinks< Links, Container, Messages >::child_tail(), jeod::TreeLinks< Links, Container, Messages >::detach(), jeod::TreeLinks< Links, Container, Messages >::has_children(), links, and remove_from_↩parent().

8.5.2.3 RefFrame() [2/2]

```
jeod::RefFrame::RefFrame (
            const RefFrame & frame )  [delete]
```

8.5.3 Member Function Documentation

8.5.3.1 add_child()

```
void jeod::RefFrame::add_child (
            RefFrame & frame )  [inline], [virtual]
```

Add a child frame to this frame.

Parameters

in,out	*frame*	Frame to add as child

Definition at line 154 of file ref_frame_inline.hh.

References jeod::TreeLinks< Links, Container, Messages >::attach(), and links.

Referenced by jeod::RefFrameManager::add_frame_to_tree().

8.5.3.2 compute_position_from()

```
void jeod::RefFrame::compute_position_from (
            const RefFrame & in_frame,
            double rel_pos[3] ) const  [virtual]
```

Compute the relative position vector from the origin of the supplied reference frame to the origin of this reference frame, expressed in the coordinates of the supplied frame.

Parameters

in	*in_frame*	Relative position vector origin
out	*rel_pos*	Relative position vector Units: M

Definition at line 325 of file ref_frame_compute_relative_state.cc.

References find_last_common_index(), jeod::RefFrameMessages::invalid_node, links, name, jeod::TreeLinks< Links, Container, Messages >::path_length(), jeod::RefFrameTrans::position, jeod::RefFrameRot::Q_parent_this, jeod::RefFrameState::rot, state, jeod::RefFrameRot::T_parent_this, and jeod::RefFrameState::trans.

8.5.3.3 compute_pred_rel_state() [1/2]

```
void jeod::RefFrame::compute_pred_rel_state (
            const RefFrame & pred_frame,
            RefFrameState & rel_state ) const  [virtual]
```

Compute the complete state of the invoking reference frame with respect to the supplied reference frame, which *must* be a predecessor of the invoking frame.

Assumptions and Limitations

- The predecessor frame is a predecessor.

Parameters

in	*pred_frame*	The frame with respect to which the state is to be expressed
out	*rel_state*	The relative state

Definition at line 258 of file ref_frame_compute_relative_state.cc.

References jeod::TreeLinks< Links, Container, Messages >::find_path_index(), jeod::RefFrameMessages::invalid_node, links, name, and jeod::TreeLinks< Links, Container, Messages >::path_length().

Referenced by compute_relative_state().

8.5.3.4 compute_pred_rel_state() [2/2]

```
void jeod::RefFrame::compute_pred_rel_state (
            unsigned int pred_frame_index,
            RefFrameState & rel_state ) const  [virtual]
```

Compute the complete state of the supplied reference frame wrt the invoking reference frame.

The supplied reference frame must be a predecessor of the invoking frame.

Assumptions and Limitations

- The predecessor frame is a predecessor.

Parameters

in	*pred_frame_index*	The frame with respect to which the state is to be expressed
out	*rel_state*	The relative state

Definition at line 290 of file ref_frame_compute_relative_state.cc.

References jeod::RefFrameState::decr_right(), links, jeod::RefFrameState::negate(), jeod::TreeLinks< Links, Container, Messages >::path_length(), and state.

8.5.3.5 compute_relative_state() [1/2]

```
void jeod::RefFrame::compute_relative_state (
            const RefFrame & wrt_frame,
            RefFrameState & rel_state ) const  [virtual]
```

Compute the complete state of the invoking reference frame (∗this) with respect to the supplied wrt_frame reference frame.

The state will include:

- The position and velocity of the invoking frame with respect to the supplied wrt_frame, expressed in the coordinates of the wrt_frame.
- The angular velocity of the invoking frame with respect to the supplied wrt_frame, expressed in the coordinates of invoking frame.
- The transformation (as a matrix and a quaternion) from the supplied wrt_frame to the invoking frame.

Assumptions and Limitations

- The two frames are in the same tree.

Parameters

in	*wrt_frame*	The frame with respect to which the state is to be expressed
out	*rel_state*	The relative state

Definition at line 60 of file ref_frame_compute_relative_state.cc.

References compute_pred_rel_state(), compute_state_wrt_pred(), jeod::RefFrameState::decr_left(), find_last↩_common_index(), jeod::RefFrameState::initialize(), jeod::RefFrameMessages::invalid_node, links, name, and jeod::TreeLinks< Links, Container, Messages >::nth_from_root().

Referenced by compute_relative_state(), and transplant_node().

8.5.3.6 compute_relative_state() [2/2]

```
void jeod::RefFrame::compute_relative_state (
            const RefFrame & wrt_frame,
            bool reverse_sense,
            RefFrameState & rel_state ) const  [virtual]
```

Compute the complete state of the invoking reference frame (∗this) with respect to the supplied wrt_frame reference frame.

If reverse_sense is false, the results are those from the simpler two argument form of RefFrame::compute_relative_state. If reverse_sense is true, the results from the two argument form are transformed as follows:

- The position and velocity are those the invoking frame with respect to the supplied wrt_frame, but expressed in invoking frame coordinates.

- The angular velocity of the invoking frame with respect to the supplied wrt_frame, expressed in the coordinates of supplied wrt_frame.
- The transformation (as a matrix and a quaternion) from the invoking frame to the supplied wrt_frame.

Assumptions and Limitations

- The two frames are in the same tree.

Parameters

in	*wrt_frame*	The frame with respect to which the state is to be expressed
in	*reverse_sense*	Express position and velocity in this frame, angular velocity in the wrt_frame, and the transformations from this frame to the wrt_frame.
out	*rel_state*	The relative state

Definition at line 158 of file ref_frame_compute_relative_state.cc.

References jeod::RefFrameRot::ang_vel_this, jeod::RefFrameRot::ang_vel_unit, compute_relative_state(), jeod::RefFrameTrans::position, jeod::RefFrameRot::Q_parent_this, jeod::RefFrameState::rot, jeod::RefFrameRot::T_parent_this, jeod::RefFrameState::trans, and jeod::RefFrameTrans::velocity.

8.5.3.7 compute_state_wrt_pred() [1/2]

```
void jeod::RefFrame::compute_state_wrt_pred (
            const RefFrame & pred_frame,
            RefFrameState & rel_state ) const  [virtual]
```

Compute the complete state of the invoking reference frame with respect to the supplied reference frame, which *must* be a predecessor of the invoking frame.

Assumptions and Limitations

- The predecessor frame is a predecessor.

Parameters

in	*pred_frame*	The frame with respect to which the state is to be expressed
out	*rel_state*	The relative state

Definition at line 190 of file ref_frame_compute_relative_state.cc.

References jeod::TreeLinks< Links, Container, Messages >::find_path_index(), jeod::RefFrameMessages::invalid_node, links, name, and jeod::TreeLinks< Links, Container, Messages >::path_length().

Referenced by compute_relative_state().

8.5.3.8 compute_state_wrt_pred() [2/2]

```
void jeod::RefFrame::compute_state_wrt_pred (
             unsigned int pred_frame_index,
             RefFrameState & rel_state ) const  [virtual]
```

Compute the complete state of the invoking reference frame with respect to the supplied reference frame, which *must* be a predecessor of the invoking frame.

Assumptions and Limitations

- The predecessor frame is a predecessor.

Parameters

in	*pred_frame_index*	The frame with respect to which the state is to be expressed
out	*rel_state*	The relative state

Definition at line 222 of file ref_frame_compute_relative_state.cc.

References jeod::RefFrameState::copy(), jeod::RefFrameState::incr_left(), links, jeod::TreeLinks< Links, Container, Messages >::path_length(), and state.

8.5.3.9 find_last_common_index()

```
int jeod::RefFrame::find_last_common_index (
             const RefFrame & frame ) const  [inline], [protected]
```

Each reference frame has a path from the root of the reference frame tree to the frame in question.

The paths for two reference frames will have some initial sequence of common nodes. Find the index number of this last element in this sequence.

Returns

Last common node

Parameters

in	*frame*	Other frame

Definition at line 175 of file ref_frame_inline.hh.

References jeod::TreeLinks< Links, Container, Messages >::find_last_common_index(), and links.

Referenced by compute_position_from(), and compute_relative_state().

8.5.3.10 find_last_common_node()

```
const RefFrame * jeod::RefFrame::find_last_common_node (
            const RefFrame & frame ) const  [inline]
```

Each reference frame has a path from the root of the reference frame tree to the frame in question.

The paths for two reference frames will have some initial sequence of common nodes. Find the last element in this sequence.

Returns

Last common node

Parameters

in	*frame*	Other frame

Definition at line 188 of file ref_frame_inline.hh.

References jeod::TreeLinks< Links, Container, Messages >::container(), jeod::TreeLinks< Links, Container, Messages >::find_last_common_node(), and links.

8.5.3.11 get_name()

```
std::string jeod::RefFrame::get_name ( ) const  [inline], [virtual]
```

Return the name.

Returns

Void

Definition at line 83 of file ref_frame_inline.hh.

References name.

Referenced by jeod::RefFrameManager::add_ref_frame(), jeod::RefFrameManager::find_ref_frame(), jeod::RefFrameManager::remove_ref_frame(), and jeod::RefFrameManager::unsubscribe_to_frame().

8.5.3.12 get_owner()

```
RefFrameOwner * jeod::RefFrame::get_owner ( ) const  [inline], [virtual]
```

Return the owner of this frame.

Returns

Frame owner

Definition at line 101 of file ref_frame_inline.hh.

References owner.

8.5.3.13 get_parent()

```
const RefFrame * jeod::RefFrame::get_parent ( ) const  [inline]
```

Return the parent of this frame.

Returns

Frame parent

Definition at line 110 of file ref_frame_inline.hh.

References links, and jeod::TreeLinks< Links, Container, Messages >::parent().

8.5.3.14 get_root()

```
const RefFrame * jeod::RefFrame::get_root ( ) const  [inline]
```

Return the root of this frame's tree.

Returns

Tree root

Definition at line 119 of file ref_frame_inline.hh.

References links, and jeod::TreeLinks< Links, Container, Messages >::root().

8.5.3.15 is_progeny_of()

```
bool jeod::RefFrame::is_progeny_of (
            const RefFrame & frame ) const  [inline]
```

Return true if this frame is a progeny of the provided frame, false if not.

Returns

This is progeny of frame

Parameters

in	*frame*	Other frame

Definition at line 207 of file ref_frame_inline.hh.

References jeod::TreeLinks< Links, Container, Messages >::is_progeny_of(), and links.

8.5.3.16 make_root()

```
void jeod::RefFrame::make_root ( )  [inline], [virtual]
```

Make this frame a root frame.

Definition at line 145 of file ref_frame_inline.hh.

References links, and jeod::TreeLinks< Links, Container, Messages >::make_root().

Referenced by jeod::RefFrameManager::add_frame_to_tree().

8.5.3.17 operator=()

```
RefFrame& jeod::RefFrame::operator= (
            const RefFrame & frame )  [delete]
```

8.5.3.18 remove_from_parent()

```
void jeod::RefFrame::remove_from_parent ( )  [inline], [virtual]
```

Remove this node as a child of its parent node.

Definition at line 162 of file ref_frame_inline.hh.

References jeod::TreeLinks< Links, Container, Messages >::detach(), and links.

Referenced by ~RefFrame().

8.5.3.19 reset_parent()

```
void jeod::RefFrame::reset_parent (
            RefFrame & new_parent )  [virtual]
```

Reparent a node, without updating state.

Parameters

in	*new_parent*	New parent frame

Definition at line 109 of file ref_frame.cc.

References links, and jeod::TreeLinks< Links, Container, Messages >::reattach().

8.5.3.20 set_active_status()

```
void jeod::RefFrame::set_active_status (
            bool value )  [override], [virtual]
```

Augment Subscription::set_active_status by telling the frame owner that the active/inactive state of this frame has changed.

Parameters

in	*value*	New active value

Reimplemented from jeod::Subscription.

Definition at line 74 of file ref_frame.cc.

References jeod::RefFrameOwner::note_frame_status_change(), owner, and jeod::Subscription::set_active_↩ status().

8.5.3.21 set_name() [1/2]

```
template<typename... Type>
void jeod::RefFrame::set_name (
            const std::string & nameIn,
            Type... namesIn )  [inline]
```

Definition at line 141 of file ref_frame.hh.

References name.

8.5.3.22 set_name() [2/2]

```
void jeod::RefFrame::set_name (
            const std::string & nameIn )  [inline]
```

Definition at line 146 of file ref_frame.hh.

8.5.3.23 set_owner()

```
void jeod::RefFrame::set_owner (
            RefFrameOwner * new_owner )  [inline], [virtual]
```

Set the owner of this frame.

Parameters

in	*new_owner*	New owner

Definition at line 92 of file ref_frame_inline.hh.

References owner.

8.5.3.24 set_timestamp()

```
void jeod::RefFrame::set_timestamp (
             double time )  [inline], [virtual]
```

Set the update time of this frame.

Parameters

in	*time*	Time Units: s

Definition at line 128 of file ref_frame_inline.hh.

References update_time.

8.5.3.25 timestamp()

```
double jeod::RefFrame::timestamp ( ) const  [inline], [virtual]
```

Return the update time of this frame.

Returns

Time of last update
Units: s

Definition at line 137 of file ref_frame_inline.hh.

References update_time.

8.5.3.26 transplant_node()

```
void jeod::RefFrame::transplant_node (
             RefFrame & new_parent )  [virtual]
```

Move a node to a different place in the tree, keeping the state with respect to the root frame constant.

Parameters

in	*new_parent*	New parent frame

Definition at line 91 of file ref_frame.cc.

References compute_relative_state(), links, jeod::TreeLinks< Links, Container, Messages >::reattach(), and state.

8.5.4 Friends And Related Function Documentation

8.5.4.1 init_attrjeod__RefFrame

```
void init_attrjeod__RefFrame ( )  [friend]
```

8.5.4.2 InputProcessor

```
friend class InputProcessor  [friend]
```

Definition at line 100 of file ref_frame.hh.

8.5.4.3 RefFrameLinks

```
friend class RefFrameLinks  [friend]
```

Definition at line 100 of file ref_frame.hh.

8.5.5 Field Documentation

8.5.5.1 links

```
RefFrameLinks jeod::RefFrame::links  [protected]
```

Specifies the parent/child/sibling linkages between frames.

trick_units(–)

Definition at line 124 of file ref_frame.hh.

Referenced by add_child(), compute_position_from(), compute_pred_rel_state(), compute_relative_state(), compute_state_wrt_pred(), find_last_common_index(), find_last_common_node(), get_parent(), get_root(), is_↩progeny_of(), make_root(), remove_from_parent(), reset_parent(), transplant_node(), and ~RefFrame().

8.5.5.2 name

```
std::string jeod::RefFrame::name  [protected]
```

The identifier for this reference frame.

trick_units(–)

Definition at line 114 of file ref_frame.hh.

Referenced by compute_position_from(), compute_pred_rel_state(), compute_relative_state(), compute_state_↩ wrt_pred(), get_name(), and set_name().

8.5.5.3 owner

```
RefFrameOwner* jeod::RefFrame::owner {}  [protected]
```

The object that "owns" this frame.

trick_units(–)

Definition at line 119 of file ref_frame.hh.

Referenced by get_owner(), set_active_status(), and set_owner().

8.5.5.4 state

```
RefFrameState jeod::RefFrame::state
```

The translational and rotational state of the reference frame with respect to its parent.

trick_units(–)

Definition at line 108 of file ref_frame.hh.

Referenced by compute_position_from(), compute_pred_rel_state(), compute_state_wrt_pred(), and transplant_↩ node().

8.5.5.5 update_time

```
double jeod::RefFrame::update_time {}  [protected]
```

The time that the frame was lasted updated, dynamic time seconds.

trick_units(s)

Definition at line 129 of file ref_frame.hh.

Referenced by set_timestamp(), and timestamp().

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

- ref_frame.hh
- ref_frame_inline.hh
- ref_frame.cc
- ref_frame_compute_relative_state.cc

8.6 jeod::RefFrameItems Class Reference

Identify which aspects of a reference frame's state have been set.

`#include <ref_frame_items.hh>`

Public Types

- enum Items {
  No_Items = 0, Pos = 1, Vel = 2, Pos_Vel = 3,
  Att = 4, Pos_Att = 5, Vel_Att = 6, Pos_Vel_Att = 7,
  Rate = 8, Pos_Rate = 9, Vel_Rate = 10, Pos_Vel_Rate = 11,
  Att_Rate = 12, Pos_Att_Rate = 13, Vel_Att_Rate = 14, Pos_Vel_Att_Rate = 15 }

  The Items enumeration identifies the major items that can be set in a RefFrameState structure – position, velocity, attitude, and attitude rate.

Public Member Functions

- RefFrameItems ()

  Construct a RefFrameItems object.
- RefFrameItems (Items new_value)

  Construct a RefFrameItems object.
- Items get () const

  Get the value of a RefFrameItems.
- bool contains (Items test_items) const

  Determine if specified aspects of a RefFrameItems are set.
- bool equals (Items test_items) const

  Determine whether a RefFrameItems equals the specified aspects.
- bool is_empty () const

  Determine whether a RefFrameItems has nothing set.
- bool is_full () const

  Determine whether a RefFrameItems has all bits set.
- Items set (Items new_value)

  Set the value of a RefFrameItems.
- Items add (Items new_items)

  Set aspects of a RefFrameItems.
- Items remove (Items old_items)

  Clear aspects of a RefFrameItems.
- std::string to_string () const

  Return a string indicating the set items.

Static Public Member Functions

- static std::string to_string (Items test_items)

  Return a string indicating the set items.

Data Fields

- Items value

  Indicates which aspects of a RefFrameState have been set.

Friends

- class InputProcessor
- void init_attrjeod__RefFrameItems ()

8.6.1 Detailed Description

Identify which aspects of a reference frame's state have been set.

The aspects that are managed are the position, velocity, attitude, and attitude rate.

Definition at line 83 of file ref_frame_items.hh.

8.6.2 Member Enumeration Documentation

8.6.2.1 Items

`enum jeod::RefFrameItems::Items`

The Items enumeration identifies the major items that can be set in a RefFrameState structure – position, velocity, attitude, and attitude rate.

The enumeration values are implemented as bit flags. The four basic items, position, velocity, attitude, and rate, have values of 1, 2, 4, and 8, respectively. Combinations thereof have values corresponding to the bitwise or of the basic components.

Enumerator

No_Items	Nothing set.
Pos	Position.
Vel	Velocity.
Pos_Vel	Position + velocity.
Att	Attitude.
Pos_Att	Position + attitude.
Vel_Att	Velocity + attitude.
Pos_Vel_Att	Position + velocity + attitude.
Rate	Attitude rate.
Pos_Rate	Position + rate.
Vel_Rate	Velocity + rate.
Pos_Vel_Rate	Position + velocity + rate.
Att_Rate	Attitude + Rate.
Pos_Att_Rate	Position + attitude + Rate.
Vel_Att_Rate	Velocity + attitude + Rate.
Pos_Vel_Att_Rate	Position + velocity + attitude + Rate.

Definition at line 95 of file ref_frame_items.hh.

8.6.3 Constructor & Destructor Documentation

8.6.3.1 RefFrameItems() [1/2]

```
jeod::RefFrameItems::RefFrameItems ( )
```

Construct a RefFrameItems object.

Definition at line 101 of file ref_frame_items.cc.

References No_Items, and value.

8.6.3.2 RefFrameItems() [2/2]

```
jeod::RefFrameItems::RefFrameItems (
            Items new_value )  [explicit]
```

Construct a RefFrameItems object.

Parameters

in	*new_value*	Initial value

Definition at line 110 of file ref_frame_items.cc.

References value.

8.6.4 Member Function Documentation

8.6.4.1 add()

```
RefFrameItems::Items jeod::RefFrameItems::add (
            RefFrameItems::Items new_items )  [inline]
```

Set aspects of a RefFrameItems.

Returns

Updated value

Parameters

in	*new_items*	Items to add

Definition at line 137 of file ref_frame_items_inline.hh.

References value.

8.6.4.2 contains()

```
bool jeod::RefFrameItems::contains (
            RefFrameItems::Items test_items ) const  [inline]
```

Determine if specified aspects of a RefFrameItems are set.

Returns

Are specified items set?

Parameters

in	*test_items*	Test items

Definition at line 87 of file ref_frame_items_inline.hh.

References value.

8.6.4.3 equals()

```
bool jeod::RefFrameItems::equals (
            RefFrameItems::Items test_items ) const  [inline]
```

Determine whether a RefFrameItems equals the specified aspects.

Returns

Exact equality?

Parameters

in	*test_items*	Test items

Definition at line 98 of file ref_frame_items_inline.hh.

References value.

8.6.4.4 get()

```
RefFrameItems::Items jeod::RefFrameItems::get ( ) const  [inline]
```

Get the value of a RefFrameItems.

Returns

Current value

Definition at line 77 of file ref_frame_items_inline.hh.

References value.

8.6.4.5 is_empty()

```
bool jeod::RefFrameItems::is_empty ( ) const  [inline]
```

Determine whether a RefFrameItems has nothing set.

Returns

Nothing set?

Definition at line 107 of file ref_frame_items_inline.hh.

References No_Items, and value.

8.6.4.6 is_full()

```
bool jeod::RefFrameItems::is_full ( ) const  [inline]
```

Determine whether a RefFrameItems has all bits set.

Returns

Fully set?

Definition at line 116 of file ref_frame_items_inline.hh.

References Pos_Vel_Att_Rate, and value.

8.6.4.7 remove()

```
RefFrameItems::Items jeod::RefFrameItems::remove (
            RefFrameItems::Items old_items )  [inline]
```

Clear aspects of a RefFrameItems.

Returns

Updated value

Parameters

in	*old_items*	Items to remove

Definition at line 148 of file ref_frame_items_inline.hh.

References Pos_Vel_Att_Rate, and value.

8.6.4.8 set()

```
RefFrameItems::Items jeod::RefFrameItems::set (
            RefFrameItems::Items new_value )  [inline]
```

Set the value of a RefFrameItems.

Returns

Updated value

Parameters

in	*new_value*	New value

Definition at line 126 of file ref_frame_items_inline.hh.

References value.

8.6.4.9 to_string() [1/2]

```
std::string jeod::RefFrameItems::to_string (
            Items test_items )  [static]
```

Return a string indicating the set items.

Returns

Set items, by name

Parameters

in	*test_items*	Items enum value

Definition at line 37 of file ref_frame_items.cc.

References Att, Att_Rate, No_Items, Pos, Pos_Att, Pos_Att_Rate, Pos_Rate, Pos_Vel, Pos_Vel_Att, Pos_Vel_Att↩
_Rate, Pos_Vel_Rate, Rate, Vel, Vel_Att, Vel_Att_Rate, and Vel_Rate.

8.6.4.10 to_string() [2/2]

```
std::string jeod::RefFrameItems::to_string ( ) const
```

Return a string indicating the set items.

Returns

Set items, by name

Definition at line 119 of file ref_frame_items.cc.

References value.

8.6.5 Friends And Related Function Documentation

8.6.5.1 init_attrjeod__RefFrameItems

```
void init_attrjeod__RefFrameItems ( )  [friend]
```

8.6.5.2 InputProcessor

```
friend class InputProcessor  [friend]
```

Definition at line 85 of file ref_frame_items.hh.

8.6.6 Field Documentation

8.6.6.1 value

```
Items jeod::RefFrameItems::value
```

Indicates which aspects of a RefFrameState have been set.

trick_units(–)

Definition at line 126 of file ref_frame_items.hh.

Referenced by add(), contains(), equals(), get(), is_empty(), is_full(), RefFrameItems(), remove(), set(), and to_↩string().

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

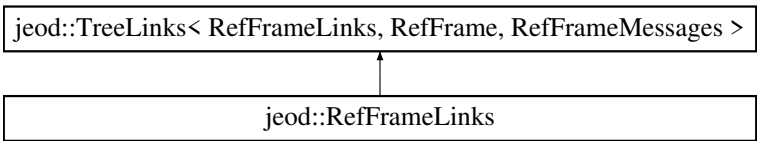
- ref_frame_items.hh
- ref_frame_items_inline.hh
- ref_frame_items.cc

8.7 jeod::RefFrameLinks Class Reference

Encapsulates the links between reference frames.

```
#include <ref_frame_links.hh>
```

Inheritance diagram for jeod::RefFrameLinks:



Public Member Functions

- RefFrameLinks (RefFrame &container_in)
  Non-default constructor.
- ~RefFrameLinks () override=default
  Destructor.
- RefFrameLinks ()=delete
- RefFrameLinks (const RefFrameLinks &)=delete
- void operator= (const RefFrameLinks &)=delete

Static Private Attributes

- static const unsigned int default_path_size = 4

Friends

- class InputProcessor
- void init_attrjeod__RefFrameLinks ()

Additional Inherited Members

8.7.1 Detailed Description

Encapsulates the links between reference frames.

Assumptions and Limitations

- Classes that use this class must keep the tree structure intact.

Definition at line 90 of file ref_frame_links.hh.

8.7.2 Constructor & Destructor Documentation

8.7.2.1 RefFrameLinks() [1/3]

```
jeod::RefFrameLinks::RefFrameLinks (
            RefFrame & container_in )  [inline], [explicit]
```

Non-default constructor.

Parameters

container_in	The RefFrame object that contains this object.

Definition at line 98 of file ref_frame_links.hh.

8.7.2.2 ~RefFrameLinks()

```
jeod::RefFrameLinks::~RefFrameLinks ( )  [override], [default]
```

Destructor.

8.7.2.3 RefFrameLinks() [2/3]

```
jeod::RefFrameLinks::RefFrameLinks ( )  [delete]
```

8.7.2.4 RefFrameLinks() [3/3]

```
jeod::RefFrameLinks::RefFrameLinks (
            const RefFrameLinks &  )  [delete]
```

8.7.3 Member Function Documentation

8.7.3.1 operator=()

```
void jeod::RefFrameLinks::operator= (
            const RefFrameLinks &  )  [delete]
```

8.7.4 Friends And Related Function Documentation

8.7.4.1 init_attrjeod__RefFrameLinks

```
void init_attrjeod__RefFrameLinks ( )  [friend]
```

8.7.4.2 InputProcessor

```
friend class InputProcessor  [friend]
```

Definition at line 92 of file ref_frame_links.hh.

8.7.5 Field Documentation

8.7.5.1 default_path_size

```
const unsigned int jeod::RefFrameLinks::default_path_size = 4  [static], [private]
```

Definition at line 115 of file ref_frame_links.hh.

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

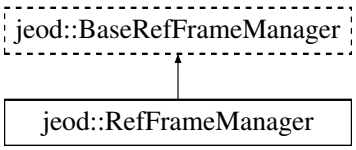
- ref_frame_links.hh

8.8 jeod::RefFrameManager Class Reference

The RefFrameManager class manages the reference frames in a simulation.

```
#include <ref_frame_manager.hh>
```

Inheritance diagram for jeod::RefFrameManager:



Public Member Functions

- RefFrameManager ()
  RefFrameManager default constructor.
- ~RefFrameManager () override
  RefFrameManager destructor.
- RefFrameManager (const RefFrameManager &)=delete
- RefFrameManager & operator= (const RefFrameManager &)=delete
- void add_ref_frame (RefFrame &ref_frame) override
  Add a reference frame to the reference frame registry.
- void remove_ref_frame (RefFrame &ref_frame) override
  Remove a reference frame from the reference frame registry.
- RefFrame * find_ref_frame (const std::string &name) const override
  Find the reference frame with the given name.
- RefFrame * find_ref_frame (const std::string &prefix, const std::string &suffix) const override
  Find the reference frame with the dot-conjoined name "${prefix}.${suffix}".
- void check_ref_frame_ownership () const override
  Check that each active reference frame has an owner.
- void reset_tree_root_node () override
  Reset the root node in anticipation of rebuilding the entire tree.
- void add_frame_to_tree (RefFrame &ref_frame, RefFrame *parent) override
  Insert a reference frame in the reference frame tree.
- void subscribe_to_frame (const std::string &frame_name) override
  Subscribe to a reference frame, with the frame specified by name.
- void subscribe_to_frame (RefFrame &frame) override

Subscribe to a reference frame, with the frame specified as an argument.

- void unsubscribe_to_frame (const std::string &frame_name) override

  Remove subscription to a reference frame, with the frame specified by name.
- void unsubscribe_to_frame (RefFrame &frame) override

  Remove subscription to a reference frame, with the frame specified as an argument.
- bool frame_is_subscribed (const std::string &frame_name) override

  Checks whether frame has subscribers; frame specified by name.
- bool frame_is_subscribed (RefFrame &frame) override

  Checks whether frame has subscribers; frame provided as an argument.

Protected Member Functions

- bool validate_name (const char *file, unsigned int line, const std::string &variable_value, const std::string &variable_type, const std::string &variable_name) const

  Check whether a name is trivially valid/invalid.

Protected Attributes

- RefFrame * root_node {}

  The root node of the reference frame tree.
- JeodPointerVector< RefFrame >::type ref_frames

  List of reference frames.

Friends

- class InputProcessor
- void init_attrjeod__RefFrameManager ()

8.8.1 Detailed Description

The RefFrameManager class manages the reference frames in a simulation.

This class is the base class for the EphemeridesManager and DynManager classes. Those derived classes add functionality to this class.

Definition at line 85 of file ref_frame_manager.hh.

8.8.2 Constructor & Destructor Documentation

8.8.2.1 RefFrameManager() [1/2]

```
jeod::RefFrameManager::RefFrameManager ( )
```

RefFrameManager default constructor.

Definition at line 44 of file ref_frame_manager.cc.

References ref_frames.

8.8.2.2 ~RefFrameManager()

```
jeod::RefFrameManager::~RefFrameManager ( )  [override]
```

RefFrameManager destructor.

Definition at line 55 of file ref_frame_manager.cc.

References ref_frames.

8.8.2.3 RefFrameManager() [2/2]

```
jeod::RefFrameManager::RefFrameManager (
            const RefFrameManager &  )  [delete]
```

8.8.3 Member Function Documentation

8.8.3.1 add_frame_to_tree()

```
void jeod::RefFrameManager::add_frame_to_tree (
            RefFrame & ref_frame,
            RefFrame * parent )  [override], [virtual]
```

Insert a reference frame in the reference frame tree.

Parameters

ref_frame	Reference frame to be added to the ref frame tree.
parent	Parent frame

Implements jeod::BaseRefFrameManager.

Definition at line 209 of file ref_frame_manager.cc.

References jeod::RefFrame::add_child(), jeod::RefFrame::make_root(), and root_node.

8.8.3.2 add_ref_frame()

```
void jeod::RefFrameManager::add_ref_frame (
            RefFrame & ref_frame )  [override], [virtual]
```

Add a reference frame to the reference frame registry.

Parameters

ref_frame	Reference frame to be added.

Implements jeod::BaseRefFrameManager.

Definition at line 68 of file ref_frame_manager.cc.

References jeod::RefFrameMessages::duplicate_entry, find_ref_frame(), jeod::RefFrame::get_name(), ref_frames, and validate_name().

8.8.3.3 check_ref_frame_ownership()

```
void jeod::RefFrameManager::check_ref_frame_ownership ( ) const  [override], [virtual]
```

Check that each active reference frame has an owner.

Implements jeod::BaseRefFrameManager.

Definition at line 179 of file ref_frame_manager.cc.

References jeod::RefFrameMessages::inconsistent_setup, and ref_frames.

8.8.3.4 find_ref_frame() [1/2]

```
RefFrame * jeod::RefFrameManager::find_ref_frame (
            const std::string & name ) const  [override], [virtual]
```

Find the reference frame with the given name.

Parameters

name	Reference frame name

Returns

Found reference frame, or NULL if not found

Implements jeod::BaseRefFrameManager.

Definition at line 132 of file ref_frame_manager.cc.

References ref_frames.

Referenced by add_ref_frame(), frame_is_subscribed(), subscribe_to_frame(), and unsubscribe_to_frame().

8.8.3.5 find_ref_frame() [2/2]

```
RefFrame * jeod::RefFrameManager::find_ref_frame (
            const std::string & prefix,
            const std::string & suffix ) const  [override], [virtual]
```

Find the reference frame with the dot-conjoined name "${prefix}.${suffix}".

Parameters

prefix	Reference frame name prefix
suffix	Reference frame name suffix

Returns

Found reference frame, or NULL if not found

Implements jeod::BaseRefFrameManager.

Definition at line 156 of file ref_frame_manager.cc.

References jeod::RefFrame::get_name(), and ref_frames.

8.8.3.6 frame_is_subscribed() [1/2]

```
bool jeod::RefFrameManager::frame_is_subscribed (
            const std::string & frame_name )  [override], [virtual]
```

Checks whether frame has subscribers; frame specified by name.

Parameters

frame_name	Name of reference frame

Returns

True if the frame has subscribers; false otherwise.

Implements jeod::BaseRefFrameManager.

Definition at line 338 of file ref_frame_manager.cc.

References find_ref_frame(), jeod::RefFrameMessages::invalid_name, and validate_name().

8.8.3.7 frame_is_subscribed() [2/2]

```
bool jeod::RefFrameManager::frame_is_subscribed (
            RefFrame & frame )  [override], [virtual]
```

Checks whether frame has subscribers; frame provided as an argument.

Parameters

frame	The reference frame

Returns

True if the frame has subscribers; false otherwise.

Implements jeod::BaseRefFrameManager.

Definition at line 369 of file ref_frame_manager.cc.

References jeod::Subscription::subscriptions().

8.8.3.8 operator=()

```
RefFrameManager& jeod::RefFrameManager::operator= (
            const RefFrameManager &  )  [delete]
```

8.8.3.9 remove_ref_frame()

```
void jeod::RefFrameManager::remove_ref_frame (
            RefFrame & ref_frame )  [override], [virtual]
```

Remove a reference frame from the reference frame registry.

Parameters

ref_frame	Reference frame to be removed.

Implements jeod::BaseRefFrameManager.

Definition at line 110 of file ref_frame_manager.cc.

References jeod::RefFrame::get_name(), ref_frames, and jeod::RefFrameMessages::removal_failed.

8.8.3.10 reset_tree_root_node()

```
void jeod::RefFrameManager::reset_tree_root_node ( )  [override], [virtual]
```

Reset the root node in anticipation of rebuilding the entire tree.

Implements jeod::BaseRefFrameManager.

Definition at line 199 of file ref_frame_manager.cc.

References root_node.

8.8.3.11 subscribe_to_frame() [1/2]

```
void jeod::RefFrameManager::subscribe_to_frame (
             const std::string & frame_name )  [override], [virtual]
```

Subscribe to a reference frame, with the frame specified by name.

Assumptions and limitations:

- A subscriber should not double-subscribe to a frame.

Parameters

frame_name	Name of reference frame

Implements jeod::BaseRefFrameManager.

Definition at line 235 of file ref_frame_manager.cc.

References find_ref_frame(), jeod::RefFrameMessages::invalid_name, and validate_name().

8.8.3.12 subscribe_to_frame() [2/2]

```
void jeod::RefFrameManager::subscribe_to_frame (
             RefFrame & frame )  [override], [virtual]
```

Subscribe to a reference frame, with the frame specified as an argument.

Assumptions and limitations:

- A subscriber should not double-subscribe to a frame.

Parameters

frame	The reference frame to be subscribed to.

Implements jeod::BaseRefFrameManager.

Definition at line 270 of file ref_frame_manager.cc.

References jeod::Subscription::subscribe().

8.8.3.13 unsubscribe_to_frame() [1/2]

```
void jeod::RefFrameManager::unsubscribe_to_frame (
            const std::string & frame_name )  [override], [virtual]
```

Remove subscription to a reference frame, with the frame specified by name.

Assumptions and limitations:

- The caller is subscribed to the frame.

Parameters

frame_name	Name of reference frame

Implements jeod::BaseRefFrameManager.

Definition at line 283 of file ref_frame_manager.cc.

References find_ref_frame(), jeod::RefFrameMessages::invalid_name, and validate_name().

8.8.3.14 unsubscribe_to_frame() [2/2]

```
void jeod::RefFrameManager::unsubscribe_to_frame (
            RefFrame & frame )  [override], [virtual]
```

Remove subscription to a reference frame, with the frame specified as an argument.

Assumptions and limitations:

- The caller is subscribed to the frame.

Parameters

frame	The reference frame

Implements jeod::BaseRefFrameManager.

Definition at line 318 of file ref_frame_manager.cc.

References jeod::RefFrame::get_name(), jeod::RefFrameMessages::invalid_item, jeod::Subscription::subscriptions(), and jeod::Subscription::unsubscribe().

8.8.3.15 validate_name()

```
bool jeod::RefFrameManager::validate_name (
            const char * file,
            unsigned int line,
            const std::string & variable_value,
            const std::string & variable_type,
            const std::string & variable_name ) const  [protected]
```

Check whether a name is trivially valid/invalid.

Parameters

file	Usually **FILE**
line	Usually **LINE**
variable_value	Value to check
variable_type	Variable description
variable_name	Variable name

Returns

True if the name is valid, false if invalid.

Definition at line 387 of file ref_frame_manager.cc.

References jeod::RefFrameMessages::invalid_name.

Referenced by add_ref_frame(), frame_is_subscribed(), subscribe_to_frame(), and unsubscribe_to_frame().

8.8.4 Friends And Related Function Documentation

8.8.4.1 init_attrjeod__RefFrameManager

```
void init_attrjeod__RefFrameManager ( )  [friend]
```

8.8.4.2 InputProcessor

```
friend class InputProcessor  [friend]
```

Definition at line 87 of file ref_frame_manager.hh.

8.8.5 Field Documentation

8.8.5.1 ref_frames

```
JeodPointerVector<RefFrame>::type jeod::RefFrameManager::ref_frames  [protected]
```

List of reference frames.

trick_io(**)

Definition at line 152 of file ref_frame_manager.hh.

Referenced by add_ref_frame(), check_ref_frame_ownership(), find_ref_frame(), RefFrameManager(), remove_ref_frame(), and ~RefFrameManager().

8.8.5.2 root_node

```
RefFrame* jeod::RefFrameManager::root_node {}  [protected]
```

The root node of the reference frame tree.

This reference frame is the true inertial frame of the simulation.trick_units(–)

Definition at line 147 of file ref_frame_manager.hh.

Referenced by add_frame_to_tree(), and reset_tree_root_node().

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

- ref_frame_manager.hh
- ref_frame_manager.cc

8.9 jeod::RefFrameMessages Class Reference

Declares messages associated with the reference frames model.

```
#include <ref_frame_messages.hh>
```

Public Member Functions

- RefFrameMessages ()=delete
- RefFrameMessages (const RefFrameMessages &)=delete
- RefFrameMessages & operator= (const RefFrameMessages &)=delete

Static Public Attributes

- static const char * attach_info = "utils/ref_frames/" "attach_info"
  Issued to provide information regarding an attachment.
- static const char * duplicate_entry = "utils/ref_frames/" "duplicate_entry"
  Issued when a duplicate reference frame is detected (name or address).
- static const char * inconsistent_setup = "utils/ref_frames/" "inconsistent_setup"
  Issued when some inconsistency is detected.
- static const char * internal_error = "utils/ref_frames/" "internal_error"
  Error issued when some internal error occurred.
- static const char * invalid_attach = "utils/ref_frames/" "invalid_attach"
  Issued when an attachment cannot be performed as requested.
- static const char * invalid_detach = "utils/ref_frames/" "invalid_detach"
  Issued when a detachment cannot be performed as requested.
- static const char * invalid_enum = "utils/ref_frames/" "invalid_enum"
  Issued when a enum value is not one of the enumerated values.
- static const char * invalid_item = "utils/ref_frames/" "invalid_item"
  Issued when something other than an enum, name, or node is invalid.
- static const char * invalid_name = "utils/ref_frames/" "invalid_name"
  Issued when a name is invalid – NULL, empty, a duplicate, ...
- static const char * invalid_node = "utils/ref_frames/" "invalid_node"
  Issued when a node does not have expected linkages.
- static const char * null_pointer = "utils/ref_frames/" "null_pointer"
  Issued when a pointer that is null should be non-null.
- static const char * subscription_error = "utils/ref_frames/" "subscription_error"
  Error issued when a problem is detected in the subscription model.
- static const char * removal_failed = "utils/ref_frames/" "removal_failed"
  Error issued when a removal cannot be performed because the frame is not registered.

Friends

- class InputProcessor
- void init_attrjeod__RefFrameMessages ()

8.9.1 Detailed Description

Declares messages associated with the reference frames model.

Definition at line 82 of file ref_frame_messages.hh.

8.9.2 Constructor & Destructor Documentation

8.9.2.1 RefFrameMessages() [1/2]

```
jeod::RefFrameMessages::RefFrameMessages ( )  [delete]
```

8.9.2.2 RefFrameMessages() [2/2]

```
jeod::RefFrameMessages::RefFrameMessages (
            const RefFrameMessages &  )  [delete]
```

8.9.3 Member Function Documentation

8.9.3.1 operator=()

```
RefFrameMessages& jeod::RefFrameMessages::operator= (
            const RefFrameMessages &  )  [delete]
```

8.9.4 Friends And Related Function Documentation

8.9.4.1 init_attrjeod__RefFrameMessages

```
void init_attrjeod__RefFrameMessages ( )  [friend]
```

8.9.4.2 InputProcessor

```
friend class InputProcessor  [friend]
```

Definition at line 84 of file ref_frame_messages.hh.

8.9.5 Field Documentation

8.9.5.1 attach_info

```
char const * jeod::RefFrameMessages::attach_info = "utils/ref_frames/" "attach_info"  [static]
```

Issued to provide information regarding an attachment.

trick_units(–)

Definition at line 89 of file ref_frame_messages.hh.

8.9.5.2 duplicate_entry

```
char const * jeod::RefFrameMessages::duplicate_entry = "utils/ref_frames/" "duplicate_entry"
[static]
```

Issued when a duplicate reference frame is detected (name or address).

trick_units(–)

Definition at line 94 of file ref_frame_messages.hh.

Referenced by jeod::RefFrameManager::add_ref_frame().

8.9.5.3 inconsistent_setup

```
char const * jeod::RefFrameMessages::inconsistent_setup = "utils/ref_frames/" "inconsistent_↩
setup"  [static]
```

Issued when some inconsistency is detected.

trick_units(–)

Definition at line 99 of file ref_frame_messages.hh.

Referenced by jeod::RefFrameManager::check_ref_frame_ownership().

8.9.5.4 internal_error

```
char const * jeod::RefFrameMessages::internal_error = "utils/ref_frames/" "internal_error"
[static]
```

Error issued when some internal error occurred.

These errors should never happen.trick_units(–)

Definition at line 105 of file ref_frame_messages.hh.

8.9.5.5 invalid_attach

```
char const * jeod::RefFrameMessages::invalid_attach = "utils/ref_frames/" "invalid_attach"
[static]
```

Issued when an attachment cannot be performed as requested.

trick_units(–)

Definition at line 110 of file ref_frame_messages.hh.

8.9.5.6 invalid_detach

```
char const * jeod::RefFrameMessages::invalid_detach = "utils/ref_frames/" "invalid_detach"
[static]
```

Issued when a detachment cannot be performed as requested.

trick_units(–)

Definition at line 115 of file ref_frame_messages.hh.

8.9.5.7 invalid_enum

```
char const * jeod::RefFrameMessages::invalid_enum = "utils/ref_frames/" "invalid_enum"  [static]
```

Issued when a enum value is not one of the enumerated values.

trick_units(–)

Definition at line 120 of file ref_frame_messages.hh.

8.9.5.8 invalid_item

```
char const * jeod::RefFrameMessages::invalid_item = "utils/ref_frames/" "invalid_item"  [static]
```

Issued when something other than an enum, name, or node is invalid.

trick_units(–)

Definition at line 125 of file ref_frame_messages.hh.

Referenced by jeod::RefFrameManager::unsubscribe_to_frame().

8.9.5.9 invalid_name

```
char const * jeod::RefFrameMessages::invalid_name = "utils/ref_frames/" "invalid_name"  [static]
```

Issued when a name is invalid – NULL, empty, a duplicate, ...

trick_units(–)

Definition at line 130 of file ref_frame_messages.hh.

Referenced by jeod::RefFrameManager::frame_is_subscribed(), jeod::RefFrameManager::subscribe_to_frame(), jeod::RefFrameManager::unsubscribe_to_frame(), and jeod::RefFrameManager::validate_name().

8.9.5.10 invalid_node

```
char const * jeod::RefFrameMessages::invalid_node = "utils/ref_frames/" "invalid_node"  [static]
```

Issued when a node does not have expected linkages.

trick_units(–)

Definition at line 135 of file ref_frame_messages.hh.

Referenced by jeod::RefFrame::compute_position_from(), jeod::RefFrame::compute_pred_rel_state(), jeod::Ref↩ Frame::compute_relative_state(), and jeod::RefFrame::compute_state_wrt_pred().

8.9.5.11 null_pointer

```
char const * jeod::RefFrameMessages::null_pointer = "utils/ref_frames/" "null_pointer"  [static]
```

Issued when a pointer that is null should be non-null.

trick_units(–)

Definition at line 140 of file ref_frame_messages.hh.

8.9.5.12 removal_failed

```
char const * jeod::RefFrameMessages::removal_failed = "utils/ref_frames/" "removal_failed"
[static]
```

Error issued when a removal cannot be performed because the frame is not registered.

trick_units(–)

Definition at line 151 of file ref_frame_messages.hh.

Referenced by jeod::RefFrameManager::remove_ref_frame().

8.9.5.13 subscription_error

```
char const * jeod::RefFrameMessages::subscription_error = "utils/ref_frames/" "subscription_↩
error"  [static]
```

Error issued when a problem is detected in the subscription model.

trick_units(–)

Definition at line 145 of file ref_frame_messages.hh.

Referenced by jeod::Subscription::activate(), jeod::Subscription::deactivate(), jeod::Subscription::subscribe(), and jeod::Subscription::unsubscribe().

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

- ref_frame_messages.hh
- ref_frame_messages.cc

8.10 jeod::RefFrameOwner Class Reference

Identify an object as an "owner" of a reference frame.

`#include <ref_frame_interface.hh>`

Public Member Functions

- RefFrameOwner ()=default
  RefFrameOwner default constructor.
- virtual ~RefFrameOwner ()=default
  RefFrameOwner destructor.
- virtual void note_frame_status_change (RefFrame *frame)
  Note that a reference frame has changed its active/inactive status.

8.10.1 Detailed Description

Identify an object as an "owner" of a reference frame.

This class is an interface – it has no member data. It instead defines minimal capabilities common to all things that can "own" a reference frame.

This interface class is one of the very few classes that JEOD uses in the form of multiple inheritance.

Definition at line 80 of file ref_frame_interface.hh.

8.10.2 Constructor & Destructor Documentation

8.10.2.1 RefFrameOwner()

```
jeod::RefFrameOwner::RefFrameOwner ( )  [default]
```

RefFrameOwner default constructor.

8.10.2.2 ~RefFrameOwner()

```
virtual jeod::RefFrameOwner::~RefFrameOwner ( )  [virtual], [default]
```

RefFrameOwner destructor.

8.10.3 Member Function Documentation

8.10.3.1 note_frame_status_change()

```
virtual void jeod::RefFrameOwner::note_frame_status_change (
            RefFrame * frame )  [inline], [virtual]
```

Note that a reference frame has changed its active/inactive status.

This default implementation does nothing.

Parameters

frame	Frame whose status has changed

Definition at line 101 of file ref_frame_interface.hh.

Referenced by jeod::RefFrame::set_active_status().

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

- ref_frame_interface.hh

8.11 jeod::RefFrameRot Class Reference

Represent the rotational aspects of a reference frame's state.

`#include <ref_frame_state.hh>`

Public Member Functions

- RefFrameRot ()

  Default constructor; initializes state to a null rotation.
- ~RefFrameRot ()=default
- RefFrameRot (const RefFrameRot &source)

  Copy constructor; initializes state to that of the source.
- RefFrameRot & operator= (const RefFrameRot &source)

  Assignment operator; copies state from the source.
- void initialize ()

  Initialize a RefFrameRot to a null offset.
- void copy (const RefFrameRot &source)

  Initialize a RefFrameRot from a source state.
- void compute_transformation ()

  Compute the transformation matrix from the left quaternion.
- void compute_quaternion ()

  Compute the left quaternion from the transformation matrix.
- void compute_ang_vel_unit ()

  Compute the angular velocity unit vector.
- void compute_ang_vel_products ()

  Compute the angular velocity magnitude and unit vector.

Data Fields

- Quaternion Q_parent_this

  Left transformation quaternion from the parent reference frame to the subject reference frame.
- double T_parent_this [3][3] {IDENTITY_3X3}

  Transformation matrix from the parent reference frame to the subject reference frame.
- double ang_vel_this [3] {}

  Angular velocity of the subject reference frame with respect to the parent reference frame expressed in subject reference frame coordinates.
- double ang_vel_mag {}

  Magnitude of ang_vel_this.
- double ang_vel_unit [3] {}

  Unit vector in the direction of ang_vel_this.

Friends

- class InputProcessor
- void init_attrjeod__RefFrameRot ()

8.11.1 Detailed Description

Represent the rotational aspects of a reference frame's state.

Definition at line 119 of file ref_frame_state.hh.

8.11.2 Constructor & Destructor Documentation

8.11.2.1 RefFrameRot() [1/2]

```
jeod::RefFrameRot::RefFrameRot ( )  [inline]
```

Default constructor; initializes state to a null rotation.

Definition at line 117 of file ref_frame_state_inline.hh.

References initialize().

8.11.2.2 ~RefFrameRot()

```
jeod::RefFrameRot::~RefFrameRot ( )  [default]
```

8.11.2.3 RefFrameRot() [2/2]

```
jeod::RefFrameRot::RefFrameRot (
            const RefFrameRot & source )  [inline]
```

Copy constructor; initializes state to that of the source.

Parameters

in	*source*	Source state

Definition at line 126 of file ref_frame_state_inline.hh.

References copy().

8.11.3 Member Function Documentation

8.11.3.1 compute_ang_vel_products()

```
void jeod::RefFrameRot::compute_ang_vel_products ( )  [inline]
```

Compute the angular velocity magnitude and unit vector.

Definition at line 193 of file ref_frame_state_inline.hh.

References ang_vel_mag, ang_vel_this, and compute_ang_vel_unit().

Referenced by jeod::RefFrameState::decr_left(), jeod::RefFrameState::decr_right(), jeod::RefFrameState::incr_left(), and jeod::RefFrameState::incr_right().

8.11.3.2 compute_ang_vel_unit()

```
void jeod::RefFrameRot::compute_ang_vel_unit ( )  [inline]
```

Compute the angular velocity unit vector.

Assumptions and Limitations

- Angular velocity magnitude has already been computed.

Definition at line 178 of file ref_frame_state_inline.hh.

References ang_vel_mag, ang_vel_this, and ang_vel_unit.

Referenced by compute_ang_vel_products().

8.11.3.3 compute_quaternion()

```
void jeod::RefFrameRot::compute_quaternion ( )  [inline]
```

Compute the left quaternion from the transformation matrix.

Definition at line 167 of file ref_frame_state_inline.hh.

References Q_parent_this, and T_parent_this.

8.11.3.4 compute_transformation()

```
void jeod::RefFrameRot::compute_transformation ( )  [inline]
```

Compute the transformation matrix from the left quaternion.

Definition at line 159 of file ref_frame_state_inline.hh.

References Q_parent_this, and T_parent_this.

Referenced by jeod::RefFrameState::decr_left(), jeod::RefFrameState::decr_right(), jeod::RefFrameState::incr_left(), and jeod::RefFrameState::incr_right().

8.11.3.5 copy()

```
void jeod::RefFrameRot::copy (
            const RefFrameRot & source )  [inline]
```

Initialize a RefFrameRot from a source state.

Parameters

in	*source*	Source state

Definition at line 147 of file ref_frame_state_inline.hh.

References ang_vel_mag, ang_vel_this, ang_vel_unit, Q_parent_this, and T_parent_this.

Referenced by jeod::RefFrameState::copy(), jeod::RefFrameState::incr_right(), operator=(), and RefFrameRot().

8.11.3.6 initialize()

```
void jeod::RefFrameRot::initialize ( )  [inline]
```

Initialize a RefFrameRot to a null offset.

Definition at line 134 of file ref_frame_state_inline.hh.

References ang_vel_mag, ang_vel_this, ang_vel_unit, Q_parent_this, and T_parent_this.

Referenced by jeod::RefFrameState::initialize(), jeod::RefFrameState::negate(), and RefFrameRot().

8.11.3.7 operator=()

```
RefFrameRot & jeod::RefFrameRot::operator= (
            const RefFrameRot & source )
```

Assignment operator; copies state from the source.

Returns

Pointer to this

Parameters

in	*source*	Source state

Definition at line 134 of file ref_frame_state.cc.

References copy().

8.11.4 Friends And Related Function Documentation

8.11.4.1 init_attrjeod__RefFrameRot

```
void init_attrjeod__RefFrameRot ( )  [friend]
```

8.11.4.2 InputProcessor

```
friend class InputProcessor  [friend]
```

Definition at line 121 of file ref_frame_state.hh.

8.11.5 Field Documentation

8.11.5.1 ang_vel_mag

```
double jeod::RefFrameRot::ang_vel_mag {}
```

Magnitude of ang_vel_this.

trick_units(rad/s)

Definition at line 144 of file ref_frame_state.hh.

Referenced by compute_ang_vel_products(), compute_ang_vel_unit(), copy(), jeod::RefFrameState::decr_left(), jeod::RefFrameState::decr_right(), jeod::RefFrameState::incr_left(), jeod::RefFrameState::incr_right(), initialize(), and jeod::RefFrameState::negate().

8.11.5.2 ang_vel_this

```
double jeod::RefFrameRot::ang_vel_this[3] {}
```

Angular velocity of the subject reference frame with respect to the parent reference frame expressed in subject reference frame coordinates.

trick_units(rad/s)

Definition at line 139 of file ref_frame_state.hh.

Referenced by compute_ang_vel_products(), compute_ang_vel_unit(), jeod::RefFrame::compute_relative_state(), copy(), jeod::RefFrameState::decr_left(), jeod::RefFrameState::decr_right(), jeod::RefFrameState::incr_left(), jeod::RefFrameState::incr_right(), initialize(), and jeod::RefFrameState::negate().

8.11.5.3 ang_vel_unit

```
double jeod::RefFrameRot::ang_vel_unit[3] {}
```

Unit vector in the direction of ang_vel_this.

trick_units(–)

Definition at line 149 of file ref_frame_state.hh.

Referenced by compute_ang_vel_unit(), jeod::RefFrame::compute_relative_state(), copy(), initialize(), and jeod::RefFrameState::negate().

8.11.5.4 Q_parent_this

```
Quaternion jeod::RefFrameRot::Q_parent_this
```

Left transformation quaternion from the parent reference frame to the subject reference frame.

trick_units(–)

Definition at line 127 of file ref_frame_state.hh.

Referenced by jeod::RefFrame::compute_position_from(), compute_quaternion(), jeod::RefFrame::compute_relative_state(), compute_transformation(), copy(), jeod::RefFrameState::decr_left(), jeod::RefFrameState::decr_right(), jeod::RefFrameState::incr_left(), jeod::RefFrameState::incr_right(), initialize(), and jeod::RefFrameState::negate().

8.11.5.5 T_parent_this

```
double jeod::RefFrameRot::T_parent_this[3][3] {IDENTITY_3X3}
```

Transformation matrix from the parent reference frame to the subject reference frame.

trick_units(–)

Definition at line 133 of file ref_frame_state.hh.

Referenced by jeod::RefFrame::compute_position_from(), compute_quaternion(), jeod::RefFrame::compute_relative_state(), compute_transformation(), copy(), jeod::RefFrameState::decr_left(), jeod::RefFrameState::decr_right(), jeod::RefFrameState::incr_left(), jeod::RefFrameState::incr_right(), initialize(), and jeod::RefFrameState::negate().

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

- ref_frame_state.hh
- ref_frame_state_inline.hh
- ref_frame_state.cc

8.12 jeod::RefFrameState Class Reference

Represent a reference frame's state.

```
#include <ref_frame_state.hh>
```

Public Member Functions

- RefFrameState ()

  RefFrameState default constructor.
- ~RefFrameState ()=default
- RefFrameState (const RefFrameState &source)

  RefFrameState copy constructor.
- RefFrameState & operator= (const RefFrameState &source)

  Assignment operator; copies state from the source.
- void initialize ()

  Initialize a RefFrameState to a null offset.
- void copy (const RefFrameState &source)

  Initialize a RefFrameState from a source state.
- void negate (const RefFrameState &source)

  Copy a reference frame state, negated.
- void incr_left (const RefFrameState &s_ab)

  Compute S_A:C = S_A:B + S_B:C, with this initially containing S_B:C, the supplied argument containing S_A:B, and the resultant composition of states stored in this.
- void incr_right (const RefFrameState &s_bc)

  Compute S_A:C = S_A:B + S_B:C, with this initially containing S_A:B, the supplied argument containing S_B:C, and the resultant composition of states stored in this.
- void decr_left (const RefFrameState &s_ab)

  Compute S_B:C = (-S_A:B) + S_A:C, with this initially containing S_A:C, the supplied argument containing S_A:B, and the resultant composition of states stored in this.
- void decr_right (const RefFrameState &s_bc)

  Compute S_A:B = S_A:C + (-S_B:C) with this initially containing S_A:C, the supplied argument containing S_B:C, and the resultant composition of states stored in this.

Data Fields

- RefFrameTrans trans

  Translation state.
- RefFrameRot rot

  Rotational state.

Friends

- class InputProcessor
- void init_attrjeod__RefFrameState ()

8.12.1 Detailed Description

Represent a reference frame's state.

Definition at line 184 of file ref_frame_state.hh.

8.12.2 Constructor & Destructor Documentation

8.12.2.1 RefFrameState() [1/2]

```
jeod::RefFrameState::RefFrameState ( )
```

RefFrameState default constructor.

Definition at line 146 of file ref_frame_state.cc.

References initialize().

8.12.2.2 ~RefFrameState()

```
jeod::RefFrameState::~RefFrameState ( )  [default]
```

8.12.2.3 RefFrameState() [2/2]

```
jeod::RefFrameState::RefFrameState (
            const RefFrameState & source )
```

RefFrameState copy constructor.

Parameters

in	*source*	Source state

Definition at line 155 of file ref_frame_state.cc.

References copy().

8.12.3 Member Function Documentation

8.12.3.1 copy()

```
void jeod::RefFrameState::copy (
            const RefFrameState & source )  [inline]
```

Initialize a RefFrameState from a source state.

Parameters

in	*source*	Source state

Definition at line 212 of file ref_frame_state_inline.hh.

References jeod::RefFrameTrans::copy(), jeod::RefFrameRot::copy(), rot, and trans.

Referenced by jeod::RefFrame::compute_state_wrt_pred(), operator=(), and RefFrameState().

8.12.3.2 decr_left()

```
void jeod::RefFrameState::decr_left (
            const RefFrameState & s_ab )
```

Compute S_B:C = (-S_A:B) + S_A:C, with this initially containing S_A:C, the supplied argument containing S_A:B, and the resultant composition of states stored in this.

Parameters

in	*s_ab*	Left addend

Definition at line 390 of file ref_frame_state.cc.

References jeod::RefFrameRot::ang_vel_mag, jeod::RefFrameRot::ang_vel_this, jeod::RefFrameRot::compute_ang_vel_products(), jeod::RefFrameRot::compute_transformation(), jeod::RefFrameTrans::position, jeod::RefFrameRot::Q_parent_this, rot, jeod::RefFrameRot::T_parent_this, trans, and jeod::RefFrameTrans::velocity.

Referenced by jeod::RefFrame::compute_relative_state().

8.12.3.3 decr_right()

```
void jeod::RefFrameState::decr_right (
            const RefFrameState & s_bc )
```

Compute S_A:B = S_A:C + (-S_B:C) with this initially containing S_A:C, the supplied argument containing S_B:C, and the resultant composition of states stored in this.

Parameters

in	*s_bc*	Left addend

Definition at line 453 of file ref_frame_state.cc.

References jeod::RefFrameRot::ang_vel_mag, jeod::RefFrameRot::ang_vel_this, jeod::RefFrameRot::compute_ang_vel_products(), jeod::RefFrameRot::compute_transformation(), jeod::RefFrameTrans::position, jeod::RefFrameRot::Q_parent_this, rot, jeod::RefFrameRot::T_parent_this, trans, and jeod::RefFrameTrans::velocity.

Referenced by jeod::RefFrame::compute_pred_rel_state().

8.12.3.4 incr_left()

```
void jeod::RefFrameState::incr_left (
            const RefFrameState & s_ab )
```

Compute S_A:C = S_A:B + S_B:C, with this initially containing S_B:C, the supplied argument containing S_A:B, and the resultant composition of states stored in this.

Parameters

in	*s_ab*	Left addend

Definition at line 234 of file ref_frame_state.cc.

References jeod::RefFrameRot::ang_vel_mag, jeod::RefFrameRot::ang_vel_this, jeod::RefFrameRot::compute_ang_vel_products(), jeod::RefFrameRot::compute_transformation(), jeod::RefFrameTrans::position, jeod::RefFrameRot::Q_parent_this, rot, jeod::RefFrameRot::T_parent_this, trans, and jeod::RefFrameTrans::velocity.

Referenced by jeod::RefFrame::compute_state_wrt_pred().

8.12.3.5 incr_right()

```
void jeod::RefFrameState::incr_right (
            const RefFrameState & s_bc )
```

Compute S_A:C = S_A:B + S_B:C, with this initially containing S_A:B, the supplied argument containing S_B:C, and the resultant composition of states stored in this.

Note that this function is untested, as it is not used in the Reference Frame Model at any point, and is only given here as a utility function.

Parameters

in	*s_bc*	Right addend

Definition at line 313 of file ref_frame_state.cc.

References jeod::RefFrameRot::ang_vel_mag, jeod::RefFrameRot::ang_vel_this, jeod::RefFrameRot::compute_ang_vel_products(), jeod::RefFrameRot::compute_transformation(), jeod::RefFrameRot::copy(), jeod::RefFrameTrans::position, jeod::RefFrameRot::Q_parent_this, rot, jeod::RefFrameRot::T_parent_this, trans, and jeod::RefFrameTrans::velocity.

8.12.3.6 initialize()

```
void jeod::RefFrameState::initialize ( )  [inline]
```

Initialize a RefFrameState to a null offset.

Definition at line 202 of file ref_frame_state_inline.hh.

References jeod::RefFrameTrans::initialize(), jeod::RefFrameRot::initialize(), rot, and trans.

Referenced by jeod::RefFrame::compute_relative_state(), and RefFrameState().

8.12.3.7 negate()

```
void jeod::RefFrameState::negate (
            const RefFrameState & source )
```

Copy a reference frame state, negated.

Parameters

in	*source*	Source state

Definition at line 178 of file ref_frame_state.cc.

References jeod::RefFrameRot::ang_vel_mag, jeod::RefFrameRot::ang_vel_this, jeod::RefFrameRot::ang_vel_unit, jeod::RefFrameRot::initialize(), jeod::RefFrameTrans::position, jeod::RefFrameRot::Q_parent_this, rot, jeod::RefFrameRot::T_parent_this, trans, and jeod::RefFrameTrans::velocity.

Referenced by jeod::RefFrame::compute_pred_rel_state().

8.12.3.8 operator=()

```
RefFrameState & jeod::RefFrameState::operator= (
            const RefFrameState & source )
```

Assignment operator; copies state from the source.

Returns

Pointer to this

Parameters

in	*source*	Source state

Definition at line 165 of file ref_frame_state.cc.

References copy().

8.12.4 Friends And Related Function Documentation

8.12.4.1 init_attrjeod__RefFrameState

```
void init_attrjeod__RefFrameState ( )  [friend]
```

8.12.4.2 InputProcessor

```
friend class InputProcessor  [friend]
```

Definition at line 186 of file ref_frame_state.hh.

8.12.5 Field Documentation

8.12.5.1 rot

`RefFrameRot jeod::RefFrameState::rot`

Rotational state.

trick_units(–)

Definition at line 196 of file ref_frame_state.hh.

Referenced by jeod::RefFrame::compute_position_from(), jeod::RefFrame::compute_relative_state(), copy(), decr_left(), decr_right(), incr_left(), incr_right(), initialize(), and negate().

8.12.5.2 trans

`RefFrameTrans jeod::RefFrameState::trans`

Translation state.

trick_units(–)

Definition at line 191 of file ref_frame_state.hh.

Referenced by jeod::RefFrame::compute_position_from(), jeod::RefFrame::compute_relative_state(), copy(), decr_left(), decr_right(), incr_left(), incr_right(), initialize(), and negate().

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

- ref_frame_state.hh
- ref_frame_state_inline.hh
- ref_frame_state.cc

8.13 jeod::RefFrameTrans Class Reference

Represent the translational aspects of a reference frame's state.

`#include <ref_frame_state.hh>`

Public Member Functions

- RefFrameTrans ()
  Default constructor; initializes state to a null translation.
- ~RefFrameTrans ()=default
- RefFrameTrans (const RefFrameTrans &source)
  Copy constructor; initializes state to that of the source.
- RefFrameTrans & operator= (const RefFrameTrans &source)
  Assignment operator; copies state from the source.
- void initialize ()
  Initialize a RefFrameTrans to a null offset.
- void copy (const RefFrameTrans &source)
  Initialize a RefFrameTrans from a source state.

Data Fields

- double position [3] {}

  Position of the subject reference frame origin with respect to the parent frame origin and expressed in parent reference frame coordinates.
- double velocity [3] {}

  Velocity of the subject reference frame origin with respect to the parent frame origin and expressed in parent reference frame coordinates.

Friends

- class InputProcessor
- void init_attrjeod__RefFrameTrans ()

8.13.1 Detailed Description

Represent the translational aspects of a reference frame's state.

Definition at line 82 of file ref_frame_state.hh.

8.13.2 Constructor & Destructor Documentation

8.13.2.1 RefFrameTrans() [1/2]

```
jeod::RefFrameTrans::RefFrameTrans ( )  [inline]
```

Default constructor; initializes state to a null translation.

Definition at line 81 of file ref_frame_state_inline.hh.

References initialize().

8.13.2.2 ~RefFrameTrans()

```
jeod::RefFrameTrans::~RefFrameTrans ( )  [default]
```

8.13.2.3 RefFrameTrans() [2/2]

```
jeod::RefFrameTrans::RefFrameTrans (
            const RefFrameTrans & source )  [inline]
```

Copy constructor; initializes state to that of the source.

Parameters

in	*source*	Source state

Definition at line 90 of file ref_frame_state_inline.hh.

References copy().

8.13.3 Member Function Documentation

8.13.3.1 copy()

```
void jeod::RefFrameTrans::copy (
            const RefFrameTrans & source )  [inline]
```

Initialize a RefFrameTrans from a source state.

Parameters

in	*source*	Source state

Definition at line 108 of file ref_frame_state_inline.hh.

References position, and velocity.

Referenced by jeod::RefFrameState::copy(), operator=(), and RefFrameTrans().

8.13.3.2 initialize()

```
void jeod::RefFrameTrans::initialize ( )  [inline]
```

Initialize a RefFrameTrans to a null offset.

Definition at line 98 of file ref_frame_state_inline.hh.

References position, and velocity.

Referenced by jeod::RefFrameState::initialize(), and RefFrameTrans().

8.13.3.3 operator=()

```
RefFrameTrans & jeod::RefFrameTrans::operator= (
            const RefFrameTrans & source )
```

Assignment operator; copies state from the source.

Returns

Pointer to this

Parameters

in	*source*	Source state

Definition at line 120 of file ref_frame_state.cc.

References copy().

8.13.4 Friends And Related Function Documentation

8.13.4.1 init_attrjeod__RefFrameTrans

```
void init_attrjeod__RefFrameTrans ( )  [friend]
```

8.13.4.2 InputProcessor

```
friend class InputProcessor  [friend]
```

Definition at line 84 of file ref_frame_state.hh.

8.13.5 Field Documentation

8.13.5.1 position

```
double jeod::RefFrameTrans::position[3] {}
```

Position of the subject reference frame origin with respect to the parent frame origin and expressed in parent reference frame coordinates.

trick_units(m)

Definition at line 90 of file ref_frame_state.hh.

Referenced by jeod::RefFrame::compute_position_from(), jeod::RefFrame::compute_relative_state(), copy(), jeod::RefFrameState::decr_left(), jeod::RefFrameState::decr_right(), jeod::RefFrameState::incr_left(), jeod::RefFrameState::incr_right(), initialize(), and jeod::RefFrameState::negate().

8.13.5.2 velocity

```
double jeod::RefFrameTrans::velocity[3] {}
```

Velocity of the subject reference frame origin with respect to the parent frame origin and expressed in parent reference frame coordinates.

trick_units(m/s)

Definition at line 96 of file ref_frame_state.hh.

Referenced by jeod::RefFrame::compute_relative_state(), copy(), jeod::RefFrameState::decr_left(), jeod::RefFrameState::decr_right(), jeod::RefFrameState::incr_left(), jeod::RefFrameState::incr_right(), initialize(), and jeod::RefFrameState::negate().

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

- ref_frame_state.hh
- ref_frame_state_inline.hh
- ref_frame_state.cc

8.14 jeod::SubscribeInterface Class Reference

A class that inherits from the SubscribeInterface class must provide subscribe and unsubscribe methods.

```
#include <subscription.hh>
```

Public Member Functions

- SubscribeInterface ()=default
- virtual ~SubscribeInterface ()=default
- virtual void subscribe ()=0

  Add a subscription to the object.
- virtual void desubscribe ()=0

  Remove a subscription from the object.

8.14.1 Detailed Description

A class that inherits from the SubscribeInterface class must provide subscribe and unsubscribe methods.

Definition at line 101 of file subscription.hh.

8.14.2 Constructor & Destructor Documentation

8.14.2.1 SubscribeInterface()

```
jeod::SubscribeInterface::SubscribeInterface ( )  [default]
```

8.14.2.2 ~SubscribeInterface()

```
virtual jeod::SubscribeInterface::~SubscribeInterface ( )  [virtual], [default]
```

8.14.3 Member Function Documentation

8.14.3.1 desubscribe()

```
virtual void jeod::SubscribeInterface::desubscribe ( )  [pure virtual]
```

Remove a subscription from the object.

8.14.3.2 subscribe()

```
virtual void jeod::SubscribeInterface::subscribe ( )  [pure virtual]
```

Add a subscription to the object.

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

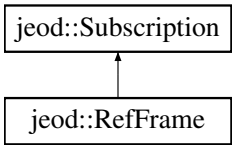
- subscription.hh

8.15 jeod::Subscription Class Reference

A Subscription object provides two approaches of marking something as being active or inactive: The activate and deactivate methods versus the subscribe and unsubscribe methods.

```
#include <subscription.hh>
```

Inheritance diagram for jeod::Subscription:



Public Types

- enum Mode { Detect = 0, Subscribe = 1, Activate = 2, Freeform = 3 }

  The Subscription::Mode enum specifies the mode in which a Subscription object is operating.

Public Member Functions

- Subscription ()=default
- Subscription (Mode)

  Subscription class non-default constructor.
- virtual ~Subscription ()=default
- bool is_active () const

  Return the value of the active data member.
- unsigned int subscriptions () const

  Return the value of the subscribers data member.
- Mode get_subscription_mode () const

  Return the value of the mode data member.
- void activate ()

  Activate a Subscription object.
- void deactivate ()

  Deactivate a Subscription object.
- void subscribe ()

  Add a subscription to a Subscription object.
- void unsubscribe ()

  Remove a subscription to a Subscription object.

Protected Member Functions

- virtual void set_subscription_mode (Mode value)

  Set the value of the mode data member.
- virtual void set_active_status (bool value)

  Set the active data member to the provided value.

Protected Attributes

- Mode mode {Detect}

  The mode in which the object is operating.
- unsigned int subscribers {}

  Number of subscribers for this object.
- bool active {}

  Flag indicating whether the object is active.

Friends

- class InputProcessor
- void init_attrjeod__Subscription ()

8.15.1 Detailed Description

A Subscription object provides two approaches of marking something as being active or inactive: The activate and deactivate methods versus the subscribe and unsubscribe methods.

The class also provides a mean for selecting only one of these two approaches as valid.

This class uses the non-virtual interface design pattern. Derived classes should not override the non-virtual public interfaces. They should instead override the private set_active_state method.

Definition at line 131 of file subscription.hh.

8.15.2 Member Enumeration Documentation

8.15.2.1 Mode

```
enum jeod::Subscription::Mode
```

The Subscription::Mode enum specifies the mode in which a Subscription object is operating.

Enumerator

Detect	First scheme used wins.
Subscribe	Activation is via subscribe/unsubscribe only.
Activate	Activation is via activate/deactivate only.
Freeform	Users can use either scheme; conflicts may arise.

Definition at line 139 of file subscription.hh.

8.15.3 Constructor & Destructor Documentation

8.15.3.1 Subscription() [1/2]

```
jeod::Subscription::Subscription ( )  [default]
```

8.15.3.2 Subscription() [2/2]

```
jeod::Subscription::Subscription (
            Mode init_mode )  [inline], [explicit]
```

Subscription class non-default constructor.

Parameters

in	*init_mode*	Initial mode

Definition at line 218 of file subscription.hh.

8.15.3.3 ~Subscription()

```
virtual jeod::Subscription::~Subscription ( )  [virtual], [default]
```

8.15.4 Member Function Documentation

8.15.4.1 activate()

```
void jeod::Subscription::activate ( )
```

Activate a Subscription object.

Assumptions and Limitations

- Activation is valid for this object.

Definition at line 37 of file subscription.cc.

References Activate, active, Detect, mode, set_active_status(), Subscribe, and jeod::RefFrameMessages↩ ::subscription_error.

8.15.4.2 deactivate()

```
void jeod::Subscription::deactivate ( )
```

Deactivate a Subscription object.

Assumptions and Limitations

- Activation is valid for this object.

Definition at line 66 of file subscription.cc.

References Activate, active, Detect, mode, set_active_status(), Subscribe, and jeod::RefFrameMessages↩ ::subscription_error.

8.15.4.3 get_subscription_mode()

```
Subscription::Mode jeod::Subscription::get_subscription_mode ( ) const  [inline]
```

Return the value of the mode data member.

Returns

Operating mode.

Definition at line 254 of file subscription.hh.

8.15.4.4 is_active()

```
bool jeod::Subscription::is_active ( ) const  [inline]
```

Return the value of the active data member.

Returns

Is the object active?

Definition at line 227 of file subscription.hh.

8.15.4.5 set_active_status()

```
void jeod::Subscription::set_active_status (
            bool value )  [protected], [virtual]
```

Set the active data member to the provided value.

Parameters

in	*value*	New active value

Reimplemented in jeod::RefFrame.

Definition at line 166 of file subscription.cc.

References active.

Referenced by activate(), deactivate(), jeod::RefFrame::set_active_status(), subscribe(), and unsubscribe().

8.15.4.6 set_subscription_mode()

```
void jeod::Subscription::set_subscription_mode (
            Mode value )  [inline], [protected], [virtual]
```

Set the value of the mode data member.

Parameters

in	*value*	Subscription mode

Definition at line 245 of file subscription.hh.

Referenced by jeod::RefFrame::RefFrame().

8.15.4.7 subscribe()

```
void jeod::Subscription::subscribe ( )
```

Add a subscription to a Subscription object.

Assumptions and Limitations

- Subscription is valid for this object.

Definition at line 95 of file subscription.cc.

References Activate, active, Detect, mode, set_active_status(), Subscribe, subscribers, and jeod::RefFrameMessages::subscription_error.

Referenced by jeod::RefFrameManager::subscribe_to_frame().

8.15.4.8 subscriptions()

```
unsigned int jeod::Subscription::subscriptions ( ) const  [inline]
```

Return the value of the subscribers data member.

Returns

Number of subscriptions.

Definition at line 236 of file subscription.hh.

Referenced by jeod::RefFrameManager::frame_is_subscribed(), and jeod::RefFrameManager::unsubscribe_to_frame().

8.15.4.9 unsubscribe()

```
void jeod::Subscription::unsubscribe ( )
```

Remove a subscription to a Subscription object.

Assumptions and Limitations

- Subscription is valid for this object.

Definition at line 126 of file subscription.cc.

References Activate, active, Detect, mode, set_active_status(), Subscribe, subscribers, and jeod::RefFrameMessages::subscription_error.

Referenced by jeod::RefFrameManager::unsubscribe_to_frame().

8.15.5 Friends And Related Function Documentation

8.15.5.1 init_attrjeod__Subscription

```
void init_attrjeod__Subscription ( )  [friend]
```

8.15.5.2 InputProcessor

```
friend class InputProcessor  [friend]
```

Definition at line 133 of file subscription.hh.

8.15.6 Field Documentation

8.15.6.1 active

```
bool jeod::Subscription::active {}  [protected]
```

Flag indicating whether the object is active.

trick_units(–)

Definition at line 211 of file subscription.hh.

Referenced by activate(), deactivate(), set_active_status(), subscribe(), and unsubscribe().

8.15.6.2 mode

```
Mode jeod::Subscription::mode {Detect}  [protected]
```

The mode in which the object is operating.

trick_units(–)

Definition at line 201 of file subscription.hh.

Referenced by activate(), deactivate(), subscribe(), and unsubscribe().

8.15.6.3 subscribers

```
unsigned int jeod::Subscription::subscribers {}  [protected]
```

Number of subscribers for this object.

trick_units(–)

Definition at line 206 of file subscription.hh.

Referenced by subscribe(), and unsubscribe().

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

- subscription.hh
- subscription.cc

8.16 jeod::TreeLinks< Links, Container, Messages > Class Template Reference

Encapsulates links (parent, children, siblings) between objects, in the form of a tree.

```
#include <tree_links.hh>
```

Public Member Functions

- TreeLinks (Container &container_in, unsigned int path_size)

  Non-default constructor.
- virtual ~TreeLinks ()=default

  Destructor.
- TreeLinks ()=delete
- TreeLinks (const TreeLinks &)=delete
- TreeLinks & operator= (const TreeLinks &)=delete
- Links * child_head ()

  Reference to the first child.
- Links * child_tail ()

  Reference to the last child.
- bool is_atomic ()

  Is the body atomic – in other words, is it a leaf node?
- bool has_children ()

  Is the body non-atomic – in other words, does it have children?
- bool is_root ()

  Is the body a root node?
- Container & container ()

  Accessor for the container, non-const version.
- const Container & container () const

  Accessor for the container, const version.
- Links * links_parent ()

  Accessor for the parent links, non-const version.
- const Links * links_parent () const

  Accessor for the parent links, const version.
- Container * parent ()

  Accessor for the parent container, non-const version.
- const Container * parent () const

  Accessor for the parent container, const version.
- Links * links_root ()

  Accessor for the root links object, non-const version.
- const Links * links_root () const

  Accessor for the root links object, const version.
- Container * root ()

  Accessor for the root container object, non-const version.
- const Container * root () const

  Accessor for the root container object, const version.
- unsigned int path_length () const

  Return the length of the path_to_node_ vector.
- unsigned int find_path_index (const Links &link) const

  Find the index of the specified link in the path_to_node_.
- Container * nth_from_root (unsigned int index)

  Accessor for the nth_from_root frame, non-const version.
- const Container * nth_from_root (unsigned int index) const

  Accessor for the nth_from_root frame, const version.
- void make_root ()

  Make the links object a root object.
- void attach (Links &new_parent)

  Add this object as a child of the frame containing these links.

- void detach ()

  Detach a node from its parent.
- void reattach (Links &new_parent)

  Attach a node somewhere else.
- bool is_progeny_of (const Links &target) const

  Determine if a node is the progeny of another.
- int find_last_common_index (const Links &target) const

  Find the index of the node that represents the point of departure in the tree containing two nodes.
- const Links * find_last_common_node (const Links &target) const

  Find the node that represents the point of departure in the tree containing two nodes.

Protected Member Functions

- void construct_path_to_node ()

  Recursively construct the path_to_node.

Private Member Functions

- void attach_internal (Links &new_parent)

  Add a frame as a child of the frame containing these links.
- void detach_internal ()

  Detach a node from its parent.
- void set_path_size (unsigned int new_size)

  Ensures the path size is at least as large as specified, resizing the path_to_node array if needed.

Private Attributes

- Container & container_

  The object to which this set of links pertains; the container.
- Links * parent_

  The TreeLinks object that is the immediate parent of this TreeLinks object in the directed tree that contains this TreeLinks object.
- std::vector< Links * > children_

  The TreeLinks object's children.
- std::vector< Links * > path_to_node_

  Vector of pointers to TreeLinks nodes containing the sequence of links from the root node of the tree to this TreeLinks object.

Friends

- class InputProcessor
- template<class RLinks >
  class TreeLinksAscendRange
- template<class RLinks >
  class TreeLinksDescentRange
- template<class RLinks >
  class TreeLinksChildrenRange
- void init_attrjeod__TreeLinks ()

8.16.1 Detailed Description

template<class Links, class Container, class Messages>
class jeod::TreeLinks< Links, Container, Messages >

Encapsulates links (parent, children, siblings) between objects, in the form of a tree.

Template Parameters

Links	The class being template-instantiated.
Container	The class that contains a TreeLinks object.
Messages	A message class; must contain a invalid_node element. This class must inherit from TreeLinks. **Usage**

This template class is designed for use with the "curiously recurring template pattern". The template parameter Links must be a class that derives from TreeLinks: class DerivedClass : public TreeLinks<DerivedClass, Container, Messages>

Definition at line 98 of file tree_links.hh.

8.16.2 Constructor & Destructor Documentation

8.16.2.1 TreeLinks() [1/3]

```
template<class Links, class Container, class Messages>
jeod::TreeLinks< Links, Container, Messages >::TreeLinks (
            Container & container_in,
            unsigned int path_size )  [inline]
```

Non-default constructor.

Parameters

in,out	*container_in*	Object that contains this object
in	*path_size*	Initial size to reserve for the path

Definition at line 112 of file tree_links.hh.

8.16.2.2 ~TreeLinks()

```
template<class Links, class Container, class Messages>
virtual jeod::TreeLinks< Links, Container, Messages >::~TreeLinks ( )  [virtual], [default]
```

Destructor.

8.16.2.3 TreeLinks() [2/3]

```
template<class Links, class Container, class Messages>
jeod::TreeLinks< Links, Container, Messages >::TreeLinks ( )  [delete]
```

8.16.2.4 TreeLinks() [3/3]

```
template<class Links, class Container, class Messages>
jeod::TreeLinks< Links, Container, Messages >::TreeLinks (
            const TreeLinks< Links, Container, Messages > &  )  [delete]
```

8.16.3 Member Function Documentation

8.16.3.1 attach()

```
template<class Links, class Container, class Messages>
void jeod::TreeLinks< Links, Container, Messages >::attach (
            Links & new_parent )  [inline]
```

Add this object as a child of the frame containing these links.

This object must have no parent, no siblings.

Parameters

new_parent	Links object that is to be the parent of this object.

Definition at line 352 of file tree_links.hh.

Referenced by jeod::RefFrame::add_child().

8.16.3.2 attach_internal()

```
template<class Links, class Container, class Messages>
void jeod::TreeLinks< Links, Container, Messages >::attach_internal (
            Links & new_parent )  [inline], [private]
```

Add a frame as a child of the frame containing these links.

Parameters

new_parent	The node to which this object is to be attached.

Definition at line 527 of file tree_links.hh.

8.16.3.3 child_head()

```
template<class Links, class Container, class Messages>
Links* jeod::TreeLinks< Links, Container, Messages >::child_head ( )  [inline]
```

Reference to the first child.

Definition at line 137 of file tree_links.hh.

8.16.3.4 child_tail()

```
template<class Links, class Container, class Messages>
Links* jeod::TreeLinks< Links, Container, Messages >::child_tail ( )  [inline]
```

Reference to the last child.

Definition at line 145 of file tree_links.hh.

Referenced by jeod::RefFrame::~RefFrame().

8.16.3.5 construct_path_to_node()

```
template<class Links, class Container, class Messages>
void jeod::TreeLinks< Links, Container, Messages >::construct_path_to_node ( )  [inline],
[protected]
```

Recursively construct the path_to_node.

Definition at line 496 of file tree_links.hh.

8.16.3.6 container() [1/2]

```
template<class Links, class Container, class Messages>
Container& jeod::TreeLinks< Links, Container, Messages >::container ( )  [inline]
```

Accessor for the container, non-const version.

Returns

Object that contains this object.

Definition at line 181 of file tree_links.hh.

Referenced by jeod::RefFrame::find_last_common_node().

8.16.3.7 container() [2/2]

```
template<class Links, class Container, class Messages>
const Container& jeod::TreeLinks< Links, Container, Messages >::container ( ) const  [inline]
```

Accessor for the container, const version.

Returns

Object that contains this object.

Definition at line 190 of file tree_links.hh.

8.16.3.8 detach()

```
template<class Links, class Container, class Messages>
void jeod::TreeLinks< Links, Container, Messages >::detach ( )  [inline]
```

Detach a node from its parent.

Definition at line 383 of file tree_links.hh.

Referenced by jeod::RefFrame::remove_from_parent(), and jeod::RefFrame::~RefFrame().

8.16.3.9 detach_internal()

```
template<class Links, class Container, class Messages>
void jeod::TreeLinks< Links, Container, Messages >::detach_internal ( )  [inline], [private]
```

Detach a node from its parent.

Definition at line 539 of file tree_links.hh.

8.16.3.10 find_last_common_index()

```
template<class Links, class Container, class Messages>
int jeod::TreeLinks< Links, Container, Messages >::find_last_common_index (
            const Links & target ) const  [inline]
```

Find the index of the node that represents the point of departure in the tree containing two nodes.

Parameters

target	Some other node in the tree

Returns

Index of the last common node

Definition at line 436 of file tree_links.hh.

Referenced by jeod::RefFrame::find_last_common_index().

8.16.3.11 find_last_common_node()

```
template<class Links, class Container, class Messages>
const Links* jeod::TreeLinks< Links, Container, Messages >::find_last_common_node (
            const Links & target ) const  [inline]
```

Find the node that represents the point of departure in the tree containing two nodes.

Parameters

target	Some other node in the tree

Returns

Pointer to last common node

Definition at line 479 of file tree_links.hh.

Referenced by jeod::RefFrame::find_last_common_node().

8.16.3.12 find_path_index()

```
template<class Links, class Container, class Messages>
unsigned int jeod::TreeLinks< Links, Container, Messages >::find_path_index (
            const Links & link ) const  [inline]
```

Find the index of the specified link in the path_to_node_.

Definition at line 292 of file tree_links.hh.

Referenced by jeod::RefFrame::compute_pred_rel_state(), and jeod::RefFrame::compute_state_wrt_pred().

8.16.3.13 has_children()

```
template<class Links, class Container, class Messages>
bool jeod::TreeLinks< Links, Container, Messages >::has_children ( )  [inline]
```

Is the body non-atomic – in other words, does it have children?

Returns

True if the body has children, false otherwise.

Definition at line 163 of file tree_links.hh.

Referenced by jeod::RefFrame::~RefFrame().

8.16.3.14 is_atomic()

```
template<class Links, class Container, class Messages>
bool jeod::TreeLinks< Links, Container, Messages >::is_atomic ( )  [inline]
```

Is the body atomic – in other words, is it a leaf node?

Returns

True if the body has no children, false otherwise.

Definition at line 154 of file tree_links.hh.

8.16.3.15 is_progeny_of()

```
template<class Links, class Container, class Messages>
bool jeod::TreeLinks< Links, Container, Messages >::is_progeny_of (
            const Links & target ) const  [inline]
```

Determine if a node is the progeny of another.

Parameters

target	Target links object

Returns

True if target is an ancestor of this node, false otherwise.

Definition at line 413 of file tree_links.hh.

Referenced by jeod::RefFrame::is_progeny_of().

8.16.3.16 is_root()

```
template<class Links, class Container, class Messages>
bool jeod::TreeLinks< Links, Container, Messages >::is_root ( )  [inline]
```

Is the body a root node?

Returns

True if the parent is null, false otherwise.

Definition at line 172 of file tree_links.hh.

8.16.3.17 links_parent() [1/2]

```
template<class Links, class Container, class Messages>
Links* jeod::TreeLinks< Links, Container, Messages >::links_parent ( )  [inline]
```

Accessor for the parent links, non-const version.

Returns

Pointer to this object's parent TreeLinks object.

Definition at line 199 of file tree_links.hh.

8.16.3.18 links_parent() [2/2]

```
template<class Links, class Container, class Messages>
const Links* jeod::TreeLinks< Links, Container, Messages >::links_parent ( ) const  [inline]
```

Accessor for the parent links, const version.

Returns

Pointer to this object's parent TreeLinks object.

Definition at line 208 of file tree_links.hh.

8.16.3.19 links_root() [1/2]

```
template<class Links, class Container, class Messages>
Links* jeod::TreeLinks< Links, Container, Messages >::links_root ( )  [inline]
```

Accessor for the root links object, non-const version.

Returns

Root links object

Definition at line 249 of file tree_links.hh.

8.16.3.20 links_root() [2/2]

```
template<class Links, class Container, class Messages>
const Links* jeod::TreeLinks< Links, Container, Messages >::links_root ( ) const  [inline]
```

Accessor for the root links object, const version.

Returns

Root links object

Definition at line 258 of file tree_links.hh.

8.16.3.21 make_root()

```
template<class Links, class Container, class Messages>
void jeod::TreeLinks< Links, Container, Messages >::make_root ( )  [inline]
```

Make the links object a root object.

Definition at line 334 of file tree_links.hh.

Referenced by jeod::RefFrame::make_root().

8.16.3.22 nth_from_root() [1/2]

```
template<class Links, class Container, class Messages>
Container* jeod::TreeLinks< Links, Container, Messages >::nth_from_root (
            unsigned int index )  [inline]
```

Accessor for the nth_from_root frame, non-const version.

Parameters

index	Path index (root=0)

Returns

Nth links container

Definition at line 302 of file tree_links.hh.

Referenced by jeod::RefFrame::compute_relative_state().

8.16.3.23 nth_from_root() [2/2]

```
template<class Links, class Container, class Messages>
const Container* jeod::TreeLinks< Links, Container, Messages >::nth_from_root (
            unsigned int index ) const  [inline]
```

Accessor for the nth_from_root frame, const version.

Parameters

index	Path index (root=0)

Returns

Nth links container

Definition at line 319 of file tree_links.hh.

8.16.3.24 operator=()

```
template<class Links, class Container, class Messages>
TreeLinks& jeod::TreeLinks< Links, Container, Messages >::operator= (
            const TreeLinks< Links, Container, Messages > &  )  [delete]
```

8.16.3.25 parent() [1/2]

```
template<class Links, class Container, class Messages>
Container* jeod::TreeLinks< Links, Container, Messages >::parent ( )  [inline]
```

Accessor for the parent container, non-const version.

Returns

Pointer to this object's parent Container object.

Definition at line 217 of file tree_links.hh.

Referenced by jeod::RefFrame::get_parent().

8.16.3.26 parent() [2/2]

```
template<class Links, class Container, class Messages>
const Container* jeod::TreeLinks< Links, Container, Messages >::parent ( ) const  [inline]
```

Accessor for the parent container, const version.

Returns

Pointer to this object's parent Container object.

Definition at line 233 of file tree_links.hh.

8.16.3.27 path_length()

```
template<class Links, class Container, class Messages>
unsigned int jeod::TreeLinks< Links, Container, Messages >::path_length ( ) const  [inline]
```

Return the length of the path_to_node_ vector.

Definition at line 284 of file tree_links.hh.

Referenced by jeod::RefFrame::compute_position_from(), jeod::RefFrame::compute_pred_rel_state(), and jeod::RefFrame::compute_state_wrt_pred().

8.16.3.28 reattach()

```
template<class Links, class Container, class Messages>
void jeod::TreeLinks< Links, Container, Messages >::reattach (
            Links & new_parent )  [inline]
```

Attach a node somewhere else.

Parameters

new_parent	Links object that is to be the parent of this object.

Definition at line 396 of file tree_links.hh.

Referenced by jeod::RefFrame::reset_parent(), and jeod::RefFrame::transplant_node().

8.16.3.29 root() [1/2]

```
template<class Links, class Container, class Messages>
Container* jeod::TreeLinks< Links, Container, Messages >::root ( )  [inline]
```

Accessor for the root container object, non-const version.

Returns

Root container object

Definition at line 267 of file tree_links.hh.

Referenced by jeod::RefFrame::get_root().

8.16.3.30 root() [2/2]

```
template<class Links, class Container, class Messages>
const Container* jeod::TreeLinks< Links, Container, Messages >::root ( ) const  [inline]
```

Accessor for the root container object, const version.

Returns

Root container object

Definition at line 276 of file tree_links.hh.

8.16.3.31 set_path_size()

```
template<class Links, class Container, class Messages>
void jeod::TreeLinks< Links, Container, Messages >::set_path_size (
            unsigned int new_size )  [inline], [private]
```

Ensures the path size is at least as large as specified, resizing the path_to_node array if needed.

Parameters

new_size	Requested size

Definition at line 556 of file tree_links.hh.

8.16.4 Friends And Related Function Documentation

8.16.4.1 init_attrjeod__TreeLinks

```
template<class Links, class Container, class Messages>
void init_attrjeod__TreeLinks ( )  [friend]
```

8.16.4.2 InputProcessor

```
template<class Links, class Container, class Messages>
friend class InputProcessor  [friend]
```

Definition at line 100 of file tree_links.hh.

8.16.4.3 TreeLinksAscendRange

```
template<class Links, class Container, class Messages>
template<class RLinks >
friend class TreeLinksAscendRange  [friend]
```

Definition at line 102 of file tree_links.hh.

8.16.4.4 TreeLinksChildrenRange

```
template<class Links, class Container, class Messages>
template<class RLinks >
friend class TreeLinksChildrenRange  [friend]
```

Definition at line 104 of file tree_links.hh.

8.16.4.5 TreeLinksDescentRange

```
template<class Links, class Container, class Messages>
template<class RLinks >
friend class TreeLinksDescentRange  [friend]
```

Definition at line 103 of file tree_links.hh.

8.16.5 Field Documentation

8.16.5.1 children_

```
template<class Links, class Container, class Messages>
std::vector<Links *> jeod::TreeLinks< Links, Container, Messages >::children_  [private]
```

The TreeLinks object's children.

trick_units(–)

Definition at line 580 of file tree_links.hh.

8.16.5.2 container_

```
template<class Links, class Container, class Messages>
Container& jeod::TreeLinks< Links, Container, Messages >::container_  [private]
```

The object to which this set of links pertains; the container.

trick_units(–)

Definition at line 568 of file tree_links.hh.

8.16.5.3 parent_

```
template<class Links, class Container, class Messages>
Links* jeod::TreeLinks< Links, Container, Messages >::parent_  [private]
```

The TreeLinks object that is the immediate parent of this TreeLinks object in the directed tree that contains this TreeLinks object.

This pointer is null for all root objects.trick_units(–)

Definition at line 575 of file tree_links.hh.

8.16.5.4 path_to_node_

```
template<class Links, class Container, class Messages>
std::vector<Links *> jeod::TreeLinks< Links, Container, Messages >::path_to_node_  [private]
```

Vector of pointers to TreeLinks nodes containing the sequence of links from the root node of the tree to this TreeLinks object.

The path_to_node_ remains empty until the links object is made viable by either a call to attach() or to make_root(). The zeroth element of this array is the root object. The last element is this node.trick_units(–)

Definition at line 590 of file tree_links.hh.

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

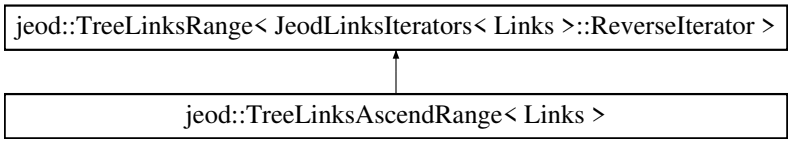
- tree_links.hh

8.17 jeod::TreeLinksAscendRange< Links > Class Template Reference

A TreeLinksAscendRange walks up a Links object's path_to_node_ data member, starting at the start node and ending just before the end node.

```
#include <tree_links.hh>
```

Inheritance diagram for jeod::TreeLinksAscendRange< Links >:



Public Types

- using ReverseIterator = typename JeodLinksIterators< Links >::ReverseIterator

Public Member Functions

- TreeLinksAscendRange (Links &links)

  Non-default constructor.
- TreeLinksAscendRange (Links &links, unsigned int start_index, unsigned int end_index=0)

  Non-default constructor.

8.17.1 Detailed Description

template<class Links>
class jeod::TreeLinksAscendRange< Links >

A TreeLinksAscendRange walks up a Links object's path_to_node_ data member, starting at the start node and ending just before the end node.

Definition at line 81 of file tree_links.hh.

8.17.2 Member Typedef Documentation

8.17.2.1 ReverseIterator

```
template<class Links >
using jeod::TreeLinksAscendRange< Links >::ReverseIterator = typename JeodLinksIterators<Links>↩
::ReverseIterator
```

Definition at line 166 of file tree_links_iterator.hh.

8.17.3 Constructor & Destructor Documentation

8.17.3.1 TreeLinksAscendRange() [1/2]

```
template<class Links >
jeod::TreeLinksAscendRange< Links >::TreeLinksAscendRange (
            Links & links )  [inline], [explicit]
```

Non-default constructor.

Create a TreeLinksAscendRange that walks over the entire path_to_node_ from the bottom to the top.

Definition at line 173 of file tree_links_iterator.hh.

8.17.3.2 TreeLinksAscendRange() [2/2]

```
template<class Links >
jeod::TreeLinksAscendRange< Links >::TreeLinksAscendRange (
            Links & links,
            unsigned int start_index,
            unsigned int end_index = 0 )  [inline]
```

Non-default constructor.

Create a TreeLinksAscendRange given the start and end indices in the input Links object's path_to_node_ vector. Behavior is undefined if start_index > path_to_node_.size() or if end_index >= start_index.

Parameters

links	Object whose path_to_node_ vector is to be traversed, in reverse.
start_index	Index of the element in the path_to_node_ vector that immediately follows the initial element to be visited in a range-based for loop. For example, using path_to_node_.size() starts at the final element of the vector.
end_index	Index of the element in the path_to_node_ vector that is the last element to be visited in a range-based for loop. For example, using zero stops the iteration at the initial element in the vector.

Definition at line 196 of file tree_links_iterator.hh.

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

- tree_links.hh
- tree_links_iterator.hh

8.18 jeod::TreeLinksChildIterator< Links, Container > Class Template Reference

`#include <class_declarations.hh>`

8.18.1 Detailed Description

template<class Links, class Container>
class jeod::TreeLinksChildIterator< Links, Container >

Definition at line 83 of file class_declarations.hh.

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

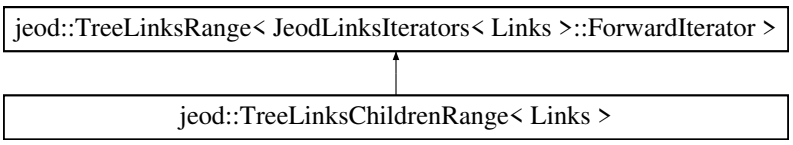
- class_declarations.hh

8.19 jeod::TreeLinksChildrenRange< Links > Class Template Reference

A TreeLinksChildrenRange walks over a Links object's children_.

`#include <tree_links.hh>`

Inheritance diagram for jeod::TreeLinksChildrenRange< Links >:



Public Types

- using ForwardIterator = typename JeodLinksIterators< Links >::ForwardIterator

Public Member Functions

- TreeLinksChildrenRange (Links &links)

  Default constructor.

8.19.1 Detailed Description

template<class Links>
class jeod::TreeLinksChildrenRange< Links >

A TreeLinksChildrenRange walks over a Links object's children_.

Definition at line 83 of file tree_links.hh.

8.19.2 Member Typedef Documentation

8.19.2.1 ForwardIterator

```
template<class Links >
using jeod::TreeLinksChildrenRange< Links >::ForwardIterator = typename JeodLinksIterators<Links>↩
::ForwardIterator
```

Definition at line 237 of file tree_links_iterator.hh.

8.19.3 Constructor & Destructor Documentation

8.19.3.1 TreeLinksChildrenRange()

```
template<class Links >
jeod::TreeLinksChildrenRange< Links >::TreeLinksChildrenRange (
            Links & links )  [inline], [explicit]
```

Default constructor.

Creates a range that will visit all children.

Definition at line 243 of file tree_links_iterator.hh.

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

- tree_links.hh
- tree_links_iterator.hh

8.20 jeod::TreeLinksDescentIterator< Links, Container > Class Template Reference

```
#include <class_declarations.hh>
```

8.20.1 Detailed Description

template<class Links, class Container>
class jeod::TreeLinksDescentIterator< Links, Container >

Definition at line 82 of file class_declarations.hh.

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

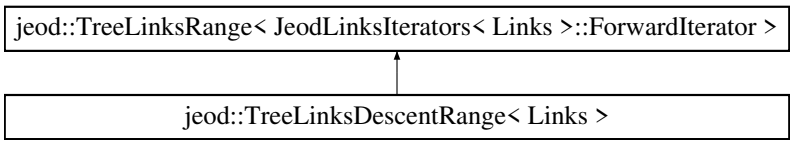
- class_declarations.hh

8.21 jeod::TreeLinksDescentRange< Links > Class Template Reference

A TreeLinksDescentRange walks down a Links object's path_to_node_ data member, starting at the start node and ending just before the end node.

`#include <tree_links.hh>`

Inheritance diagram for jeod::TreeLinksDescentRange< Links >:



Public Types

- using ForwardIterator = typename JeodLinksIterators< Links >::ForwardIterator

Public Member Functions

- TreeLinksDescentRange (Links &links, unsigned int start_index=0)

  Constructor.

8.21.1 Detailed Description

template<class Links>
class jeod::TreeLinksDescentRange< Links >

A TreeLinksDescentRange walks down a Links object's path_to_node_ data member, starting at the start node and ending just before the end node.

Definition at line 82 of file tree_links.hh.

8.21.2 Member Typedef Documentation

8.21.2.1 ForwardIterator

```
template<class Links >
using jeod::TreeLinksDescentRange< Links >::ForwardIterator = typename JeodLinksIterators<Links>↩
::ForwardIterator
```

Definition at line 211 of file tree_links_iterator.hh.

8.21.3 Constructor & Destructor Documentation

8.21.3.1 TreeLinksDescentRange()

```
template<class Links >
jeod::TreeLinksDescentRange< Links >::TreeLinksDescentRange (
            Links & links,
            unsigned int start_index = 0 )  [inline], [explicit]
```

Constructor.

Create a TreeLinksDescentRange the marches from the start_index node of the links object's path_to_node_ vector to the last node. Behavior is undefined if start_index > path_to_node_.size().

Parameters

links	Object whose path_to_node_ vector is to be traversed, in reverse.
start_index	Index of the first node the path_to_node_ vector to be visited.

Definition at line 223 of file tree_links_iterator.hh.

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

- tree_links.hh
- tree_links_iterator.hh

8.22 jeod::TreeLinksIterator< Links, Container > Class Template Reference

```
#include <class_declarations.hh>
```

8.22.1 Detailed Description

template<class Links, class Container>
class jeod::TreeLinksIterator< Links, Container >

Definition at line 80 of file class_declarations.hh.

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

- class_declarations.hh

8.23 jeod::TreeLinksParentIterator< Links, Container > Class Template Reference

`#include <class_declarations.hh>`

8.23.1 Detailed Description

template<class Links, class Container>
class jeod::TreeLinksParentIterator< Links, Container >

Definition at line 81 of file class_declarations.hh.

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

- class_declarations.hh

8.24 jeod::TreeLinksRange< Iterator > Class Template Reference

Base class template for all tree links range types.

`#include <tree_links_iterator.hh>`

Public Member Functions

- template<typename T , typename U >
  TreeLinksRange (T begin_in, U end_in)
  Constructor.
- Iterator & begin ()
  Mutable accessor to the begin_ data member.
- Iterator & end ()
  Mutable accessor to the end_ data member.

Private Attributes

- Iterator begin_
  Object returned (by reference) by the begin member function.
- Iterator end_
  Object returned (by reference) by the end member function.

8.24.1 Detailed Description

template<class Iterator>
class jeod::TreeLinksRange< Iterator >

Base class template for all tree links range types.

Template Parameters

Iterator	The type of iterator stored as the begin_ and end_ data members and returned by the begin and end member functions.

Definition at line 113 of file tree_links_iterator.hh.

8.24.2 Constructor & Destructor Documentation

8.24.2.1 TreeLinksRange()

```
template<class Iterator>
template<typename T , typename U >
jeod::TreeLinksRange< Iterator >::TreeLinksRange (
            T begin_in,
            U end_in )  [inline]
```

Constructor.

Template Parameters

T	The type of argument begin_in.
U	The type of argument end_in.

Parameters

begin_in	Value used to construct the begin_ data member.
end_in	Value used to construct the end_ data member.

Definition at line 124 of file tree_links_iterator.hh.

8.24.3 Member Function Documentation

8.24.3.1 begin()

```
template<class Iterator>
Iterator& jeod::TreeLinksRange< Iterator >::begin ( )  [inline]
```

Mutable accessor to the begin_ data member.

Definition at line 133 of file tree_links_iterator.hh.

8.24.3.2 end()

```
template<class Iterator>
Iterator& jeod::TreeLinksRange< Iterator >::end ( )  [inline]
```

Mutable accessor to the end_ data member.

Definition at line 141 of file tree_links_iterator.hh.

8.24.4 Field Documentation

8.24.4.1 begin_

```
template<class Iterator>
Iterator jeod::TreeLinksRange< Iterator >::begin_  [private]
```

Object returned (by reference) by the begin member function.

trick_units(–)

Definition at line 150 of file tree_links_iterator.hh.

Referenced by jeod::TreeLinksRange< JeodLinksIterators< Links >::ForwardIterator >::begin().

8.24.4.2 end_

```
template<class Iterator>
Iterator jeod::TreeLinksRange< Iterator >::end_  [private]
```

Object returned (by reference) by the end member function.

trick_units(–)

Definition at line 155 of file tree_links_iterator.hh.

Referenced by jeod::TreeLinksRange< JeodLinksIterators< Links >::ForwardIterator >::end().

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

- tree_links_iterator.hh

Chapter 9

File Documentation

9.1 base_ref_frame_manager.hh File Reference

Define the BaseRefFrameManager class, which defines the interfaces but not the implementations of the class RefFrameManager.

```
#include <string>
#include "utils/sim_interface/include/jeod_class.hh"
```

Data Structures

- class jeod::BaseRefFrameManager

  The RefFrameManager class manages the reference frames in a simulation.

Namespaces

- jeod

  Namespace jeod.

9.1.1 Detailed Description

Define the BaseRefFrameManager class, which defines the interfaces but not the implementations of the class RefFrameManager.

9.2 class_declarations.hh File Reference

Forward declarations of classes defined in ref_frame.hh.

Data Structures

- class jeod::TreeLinksIterator< Links, Container >
- class jeod::TreeLinksParentIterator< Links, Container >
- class jeod::TreeLinksDescentIterator< Links, Container >
- class jeod::TreeLinksChildIterator< Links, Container >

Namespaces

- jeod

  Namespace jeod.

9.2.1 Detailed Description

Forward declarations of classes defined in ref_frame.hh.

9.3 ref_frame.cc File Reference

Define basic methods for the RefFrame class.

```
#include <cstddef>
#include "utils/memory/include/jeod_alloc.hh"
#include "../include/ref_frame.hh"
#include "../include/ref_frame_interface.hh"
#include "../include/tree_links_iterator.hh"
```

Namespaces

- jeod

  Namespace jeod.

9.3.1 Detailed Description

Define basic methods for the RefFrame class.

9.4 ref_frame.hh File Reference

Define the class RefFrame.

```
#include "class_declarations.hh"
#include "ref_frame_links.hh"
#include "ref_frame_state.hh"
#include "subscription.hh"
#include "utils/named_item/include/named_item.hh"
#include "utils/sim_interface/include/jeod_class.hh"
#include <string>
#include "ref_frame_inline.hh"
#include "ref_frame_interface.hh"
```

Data Structures

- class jeod::RefFrame

  Describe a frame of reference and define operations on reference frames.

Namespaces

- jeod

  Namespace jeod.

9.4.1 Detailed Description

Define the class RefFrame.

9.5 ref_frame_compute_relative_state.cc File Reference

Define relative state methods for the RefFrame class.

```
#include <cstddef>
#include "utils/math/include/numerical.hh"
#include "utils/math/include/vector3.hh"
#include "utils/message/include/message_handler.hh"
#include "../include/ref_frame.hh"
#include "../include/ref_frame_messages.hh"
#include "../include/ref_frame_state.hh"
#include "../include/tree_links_iterator.hh"
```

Namespaces

- jeod

  Namespace jeod.

9.5.1 Detailed Description

Define relative state methods for the RefFrame class.

9.6 ref_frame_inline.hh File Reference

Define inline methods for the RefFrame class.

```
#include <cstddef>
#include "ref_frame.hh"
```

Namespaces

- jeod

  Namespace jeod.

9.6.1 Detailed Description

Define inline methods for the RefFrame class.

9.7 ref_frame_interface.hh File Reference

Define the class RefFrameOwner, which identifies an object as an "owner" of a reference frame.

```
#include "utils/sim_interface/include/jeod_class.hh"
#include "class_declarations.hh"
#include "subscription.hh"
```

Data Structures

- class jeod::RefFrameOwner

  Identify an object as an "owner" of a reference frame.

Namespaces

- jeod

  Namespace jeod.

9.7.1 Detailed Description

Define the class RefFrameOwner, which identifies an object as an "owner" of a reference frame.

9.8 ref_frame_items.cc File Reference

Define basic methods for the RefFrameState class.

```
#include "../include/ref_frame_items.hh"
```

Namespaces

- jeod

  Namespace jeod.

9.8.1 Detailed Description

Define basic methods for the RefFrameState class.

9.9 ref_frame_items.hh File Reference

Define the class RefFrameItems, which identifies the aspects of a reference frame's state that have been set.

```
#include <string>
#include "utils/sim_interface/include/jeod_class.hh"
#include "class_declarations.hh"
#include "ref_frame_items_inline.hh"
```

Data Structures

- class jeod::RefFrameItems

  Identify which aspects of a reference frame's state have been set.

Namespaces

- jeod

  Namespace jeod.

9.9.1 Detailed Description

Define the class RefFrameItems, which identifies the aspects of a reference frame's state that have been set.

9.10 ref_frame_items_inline.hh File Reference

Define inline functions for the RefFrameItems::Items.

```
#include "ref_frame_items.hh"
```

Namespaces

- jeod

  Namespace jeod.

9.10.1 Detailed Description

Define inline functions for the RefFrameItems::Items.

9.11 ref_frame_links.hh File Reference

Define the class RefFrameLinks, the class that encapsulates the links between reference frames.

```
#include "utils/sim_interface/include/jeod_class.hh"
#include "class_declarations.hh"
#include "ref_frame_messages.hh"
#include "tree_links.hh"
```

Data Structures

- class jeod::RefFrameLinks

  Encapsulates the links between reference frames.

Namespaces

- jeod

  Namespace jeod.

9.11.1 Detailed Description

Define the class RefFrameLinks, the class that encapsulates the links between reference frames.

MAINTENANCE NOTE – This file is, by intent, very similar to dynamics/mass/mass_body_links.hh. The version of Trick used at JEOD 2.0 beta release provided minimal support for templates. These two files should eventually be merged through the use of templates.

9.12 ref_frame_manager.cc File Reference

Define RefFrameManager methods.

```
#include <algorithm>
#include <cstddef>
#include "utils/memory/include/jeod_alloc.hh"
#include "utils/message/include/message_handler.hh"
#include "../include/ref_frame.hh"
#include "../include/ref_frame_manager.hh"
#include "../include/ref_frame_messages.hh"
```

Namespaces

- jeod

  Namespace jeod.

9.12.1 Detailed Description

Define RefFrameManager methods.

9.13 ref_frame_manager.hh File Reference

Define the RefFrameManager class, which manages the reference frames in a JEOD-based simulation.

```
#include "utils/container/include/pointer_vector.hh"
#include "utils/sim_interface/include/jeod_class.hh"
#include "base_ref_frame_manager.hh"
```

Data Structures

- class jeod::RefFrameManager

  The RefFrameManager class manages the reference frames in a simulation.

Namespaces

- jeod

  Namespace jeod.

9.13.1 Detailed Description

Define the RefFrameManager class, which manages the reference frames in a JEOD-based simulation.

9.14 ref_frame_messages.cc File Reference

Implement the class RefFrameMessages.

```
#include "utils/message/include/make_message_code.hh"
#include "../include/ref_frame_messages.hh"
```

Namespaces

- jeod

  Namespace jeod.

Macros

- #define MAKE_REF_FRAME_MESSAGE_CODE(id) JEOD_MAKE_MESSAGE_CODE(RefFrame↩ Messages, "utils/ref_frames/", id)

9.14.1 Detailed Description

Implement the class RefFrameMessages.

9.14.2 Macro Definition Documentation

9.14.2.1 MAKE_REF_FRAME_MESSAGE_CODE

```
#define MAKE_REF_FRAME_MESSAGE_CODE(
              id ) JEOD_MAKE_MESSAGE_CODE(RefFrameMessages, "utils/ref_frames/", id)
```

Definition at line 37 of file ref_frame_messages.cc.

9.15 ref_frame_messages.hh File Reference

Define the class RefFrameMessages, the class that specifies the message IDs used in the reference frames model.

```
#include "utils/sim_interface/include/jeod_class.hh"
```

Data Structures

- class jeod::RefFrameMessages

  Declares messages associated with the reference frames model.

Namespaces

- jeod

  Namespace jeod.

9.15.1 Detailed Description

Define the class RefFrameMessages, the class that specifies the message IDs used in the reference frames model.

9.16 ref_frame_state.cc File Reference

Define methods for the RefFrameState class.

```
#include <cmath>
#include "utils/math/include/matrix3x3.hh"
#include "utils/math/include/numerical.hh"
#include "utils/math/include/vector3.hh"
#include "../include/ref_frame_state.hh"
```

Namespaces

- jeod

  Namespace jeod.

9.16.1 Detailed Description

Define methods for the RefFrameState class.

9.17 ref_frame_state.hh File Reference

JEOD 2.0 reference frame tree class definitions.

```
#include "utils/quaternion/include/quat.hh"
#include "utils/sim_interface/include/jeod_class.hh"
#include "class_declarations.hh"
#include "utils/math/include/macro_def.hh"
#include "ref_frame_state_inline.hh"
#include "utils/math/include/macro_undef.hh"
```

Data Structures

- class jeod::RefFrameTrans

  Represent the translational aspects of a reference frame's state.
- class jeod::RefFrameRot

  Represent the rotational aspects of a reference frame's state.
- class jeod::RefFrameState

  Represent a reference frame's state.

Namespaces

- jeod

  Namespace jeod.

9.17.1 Detailed Description

JEOD 2.0 reference frame tree class definitions.

9.18 ref_frame_state_inline.hh File Reference

Define inline methods for the RefFrameState class and its component.

```
#include "utils/math/include/matrix3x3.hh"
#include "utils/math/include/vector3.hh"
#include "ref_frame_state.hh"
```

Namespaces

- jeod

  Namespace jeod.

9.18.1 Detailed Description

Define inline methods for the RefFrameState class and its component.

9.19 subscription.cc File Reference

Define non-inlined methods for the Subscription class.

```
#include "utils/message/include/message_handler.hh"
#include "../include/ref_frame_messages.hh"
#include "../include/subscription.hh"
```

Namespaces

- jeod

  Namespace jeod.

9.19.1 Detailed Description

Define non-inlined methods for the Subscription class.

9.20 subscription.hh File Reference

Define the class Subscription.

```
#include "utils/sim_interface/include/jeod_class.hh"
```

Data Structures

- class jeod::ActivateInterface

  A class that inherits from the ActivateInterface class must provide activate and deactivate methods.
- class jeod::SubscribeInterface

  A class that inherits from the SubscribeInterface class must provide subscribe and unsubscribe methods.
- class jeod::Subscription

  A Subscription object provides two approaches of marking something as being active or inactive: The activate and deactivate methods versus the subscribe and unsubscribe methods.

Namespaces

- jeod

  Namespace jeod.

9.20.1 Detailed Description

Define the class Subscription.

9.21 tree_links.hh File Reference

Define the template class TreeLinks, the class that encapsulates the parent/ child links between objects.

```
#include "class_declarations.hh"
#include "utils/container/include/pointer_vector.hh"
#include "utils/memory/include/jeod_alloc.hh"
#include "utils/message/include/message_handler.hh"
#include "utils/sim_interface/include/jeod_class.hh"
#include <algorithm>
#include <cstddef>
#include <cstring>
#include <vector>
```

Data Structures

- class jeod::TreeLinksAscendRange< Links >

  A TreeLinksAscendRange walks up a Links object's path_to_node_ data member, starting at the start node and ending just before the end node.
- class jeod::TreeLinksDescentRange< Links >

  A TreeLinksDescentRange walks down a Links object's path_to_node_ data member, starting at the start node and ending just before the end node.
- class jeod::TreeLinksChildrenRange< Links >

  A TreeLinksChildrenRange walks over a Links object's children_.
- class jeod::TreeLinks< Links, Container, Messages >

  Encapsulates links (parent, children, siblings) between objects, in the form of a tree.

Namespaces

- jeod

  Namespace jeod.

9.21.1 Detailed Description

Define the template class TreeLinks, the class that encapsulates the parent/ child links between objects.

9.22 tree_links_iterator.hh File Reference

Define the template TreeLinksRange and related templates, which are used to iterate over trees.

```
#include "class_declarations.hh"
#include "utils/sim_interface/include/jeod_class.hh"
#include <vector>
```

Data Structures

- struct jeod::JeodLinksIterators< Links >

  Class template that defines member types ForwardIterator and ReverseIterator for walking over a std::vector of pointers to Links objects.
- struct jeod::JeodLinksIterators< const Links >

  Partial specialization of JeodLinksIterators for const Links types.
- class jeod::TreeLinksRange< Iterator >

  Base class template for all tree links range types.
- class jeod::TreeLinksAscendRange< Links >

  A TreeLinksAscendRange walks up a Links object's path_to_node_ data member, starting at the start node and ending just before the end node.
- class jeod::TreeLinksDescentRange< Links >

  A TreeLinksDescentRange walks down a Links object's path_to_node_ data member, starting at the start node and ending just before the end node.
- class jeod::TreeLinksChildrenRange< Links >

  A TreeLinksChildrenRange walks over a Links object's children_.

Namespaces

- jeod

  Namespace jeod.

9.22.1 Detailed Description

Define the template TreeLinksRange and related templates, which are used to iterate over trees.

The JEOD 4.0 version of the tree links iterators is motivated by the c++11 range-based for, which requires a range expression from which a begin iterator and an end sentinel can be formed.

One way the compiler can form the begin iterator and end sentinel is to have the range expression be an object that implements begin() and end() member functions. The loops that use the JEOD 4.0 tree links iterators are of the form

```
for (auto element : TreeLinksSomeRange<LinksType>(arglist)) {
   body;
}
```

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