EarthLightingModel

5.3

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Module Documentation

5.1 Models

Modules

- Environment

5.1.1 Detailed Description

5.2 Environment

Modules

- EarthLighting

5.2.1 Detailed Description

5.3 EarthLighting

Files

- file class_declarations.hh

  Forward declarations of classes defined for JEOD 2.0 Earth Lighting.
- file earth_lighting.hh

  Calculates lighting information from the Earth, Sun and Moon for a vehicle in low Earth orbit.
- file earth_lighting_messages.hh

  Implement earth_lighting_messages.
- file earth_lighting.cc

  Implementation of the classes necessary for calculating Sun, Moon and Earth lighting effects on a vehicle orbiting the Earth.
- file earth_lighting_messages.cc

  Implement earth_lighting_messages.

Namespaces

- jeod

  Namespace jeod.

5.3.1 Detailed Description

Chapter 6

Namespace Documentation

6.1 jeod Namespace Reference

Namespace jeod.

Data Structures

- class EarthLighting

  A class for calculating lighting effects in low Earth orbit.
- class EarthLightingMessages

  Describes messages used in the earth lighting model.
- class LightingBody

  Represents a major source of light in a space environment, such as the sun, the Earth, the moon, etc.
- class LightingParams

  Contains important parameters for lighting information.

Variables

- static constexpr double epsilon = 1.0e-12

6.1.1 Detailed Description

Namespace jeod.

6.1.2 Variable Documentation

6.1.2.1 epsilon

```
constexpr double jeod::epsilon = 1.0e-12  [static]
```

Definition at line 56 of file earth_lighting.cc.

Referenced by jeod::EarthLighting::circle_intersect().

Chapter 7

Data Structure Documentation

7.1 jeod::EarthLighting Class Reference

A class for calculating lighting effects in low Earth orbit.

`#include <earth_lighting.hh>`

Public Member Functions

- EarthLighting ()=default
- ~EarthLighting ()=default
- EarthLighting & operator= (const EarthLighting &)=delete
- EarthLighting (const EarthLighting &)=delete
- void initialize (DynManager &manager)

  Initializes the EarthLighting object form the DynManager object.
- int circle_intersect (double r_bottom, double r_top, double d_centers, double *area)
- void calc_lighting (const double pos_veh[3])

  Calculate earth lighting effects at the given position.

Data Fields

- bool active {true}

  flag for if the model is active or not
- Planet * earth {}

  Pointer to the Earth planet from the DynManager.
- Planet * moon {}

  Pointer to the Moon planet from the DynManager.
- Planet * sun {}

  Pointer to the Sun planet from the DynManager.
- const RefFrame * earth_frame {}

  Pointer to the translation information for Earth inertial.
- const RefFrame * moon_frame {}

  Pointer to the translation information for Moon inertial.
- const RefFrame * sun_frame {}

  Pointer to the translation information for Sun inertial.

- LightingBody sun_body
  Sun stellar parameters.
- LightingBody earth_body
  Earth planetary parameters.
- LightingBody moon_body
  Lunar planetary parameters.
- LightingParams sun_earth
  Lighting of sun w.r.t.
- LightingParams moon_earth
  Lighting of moon w.r.t.
- LightingParams earth_albedo
  Earth albedo lighting.

Protected Attributes

- double pos_moon [3] {}
  Moon position wrt Earth inertial.
- double pos_sun [3] {}
  Sun position wrt Earth inertial.

Friends

- class InputProcessor
- void init_attrjeod__EarthLighting ()

7.1.1 Detailed Description

A class for calculating lighting effects in low Earth orbit.

Definition at line 151 of file earth_lighting.hh.

7.1.2 Constructor & Destructor Documentation

7.1.2.1 EarthLighting() [1/2]

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

7.1.2.2 ~EarthLighting()

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

7.1.2.3 EarthLighting() [2/2]

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

7.1.3 Member Function Documentation

7.1.3.1 calc_lighting()

```
void jeod::EarthLighting::calc_lighting (
            const double pos_veh[3] )
```

Calculate earth lighting effects at the given position.

Parameters

in	*pos_veh*	The position of the point of interest in the earth inertial frame Units: M

Definition at line 233 of file earth_lighting.cc.

References active, circle_intersect(), jeod::LightingBody::distance, earth_albedo, earth_body, earth_frame, jeod::LightingBody::half_angle, jeod::LightingParams::lighting, moon_body, moon_earth, moon_frame, jeod::LightingParams::obs_angle, jeod::LightingParams::occlusion, jeod::LightingParams::phase, pos_moon, pos_sun, jeod::LightingBody::position, jeod::LightingBody::radius, sun_body, sun_earth, sun_frame, and jeod::LightingParams::visible.

7.1.3.2 circle_intersect()

```
int jeod::EarthLighting::circle_intersect (
            double r_bottom,
            double r_top,
            double d_centers,
            double * area )
```

Definition at line 148 of file earth_lighting.cc.

References jeod::epsilon.

Referenced by calc_lighting().

7.1.3.3 initialize()

```
void jeod::EarthLighting::initialize (
            DynManager & manager )
```

Initializes the EarthLighting object form the DynManager object.

Will find the Earth, Sun and Moon objects and do the necessary setup to calculate earth lighting

Parameters

in	*manager*	The Dyn Manager object that includes the ephemeris for Sun, Earth and Moon

Definition at line 75 of file earth_lighting.cc.

References earth, earth_body, earth_frame, jeod::EarthLightingMessages::initialization_error, moon, moon_body, moon_frame, jeod::LightingBody::radius, sun, sun_body, and sun_frame.

7.1.3.4 operator=()

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

7.1.4 Friends And Related Function Documentation

7.1.4.1 init_attrjeod__EarthLighting

```
void init_attrjeod__EarthLighting ( )  [friend]
```

7.1.4.2 InputProcessor

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

Definition at line 153 of file earth_lighting.hh.

7.1.5 Field Documentation

7.1.5.1 active

```
bool jeod::EarthLighting::active {true}
```

flag for if the model is active or not

trick_units(–)

Definition at line 170 of file earth_lighting.hh.

Referenced by calc_lighting().

7.1.5.2 earth

```
Planet* jeod::EarthLighting::earth {}
```

Pointer to the Earth planet from the DynManager.

trick_units(–)

Definition at line 175 of file earth_lighting.hh.

Referenced by initialize().

7.1.5.3 earth_albedo

```
LightingParams jeod::EarthLighting::earth_albedo
```

Earth albedo lighting.

trick_units(–)

Definition at line 230 of file earth_lighting.hh.

Referenced by calc_lighting().

7.1.5.4 earth_body

```
LightingBody jeod::EarthLighting::earth_body
```

Earth planetary parameters.

trick_units(–)

Definition at line 210 of file earth_lighting.hh.

Referenced by calc_lighting(), and initialize().

7.1.5.5 earth_frame

```
const RefFrame* jeod::EarthLighting::earth_frame {}
```

Pointer to the translation information for Earth inertial.

trick_units(–)

Definition at line 190 of file earth_lighting.hh.

Referenced by calc_lighting(), and initialize().

7.1.5.6 moon

```
Planet* jeod::EarthLighting::moon {}
```

Pointer to the Moon planet from the DynManager.

trick_units(–)

Definition at line 180 of file earth_lighting.hh.

Referenced by initialize().

7.1.5.7 moon_body

```
LightingBody jeod::EarthLighting::moon_body
```

Lunar planetary parameters.

trick_units(–)

Definition at line 215 of file earth_lighting.hh.

Referenced by calc_lighting(), and initialize().

7.1.5.8 moon_earth

```
LightingParams jeod::EarthLighting::moon_earth
```

Lighting of moon w.r.t.

vehicle.trick_units(–)

Definition at line 225 of file earth_lighting.hh.

Referenced by calc_lighting().

7.1.5.9 moon_frame

```
const RefFrame* jeod::EarthLighting::moon_frame {}
```

Pointer to the translation information for Moon inertial.

trick_units(–)

Definition at line 195 of file earth_lighting.hh.

Referenced by calc_lighting(), and initialize().

7.1.5.10 pos_moon

```
double jeod::EarthLighting::pos_moon[3] {}  [protected]
```

Moon position wrt Earth inertial.

trick_units(m)

Definition at line 238 of file earth_lighting.hh.

Referenced by calc_lighting().

7.1.5.11 pos_sun

```
double jeod::EarthLighting::pos_sun[3] {}  [protected]
```

Sun position wrt Earth inertial.

trick_units(m)

Definition at line 243 of file earth_lighting.hh.

Referenced by calc_lighting().

7.1.5.12 sun

```
Planet* jeod::EarthLighting::sun {}
```

Pointer to the Sun planet from the DynManager.

trick_units(–)

Definition at line 185 of file earth_lighting.hh.

Referenced by initialize().

7.1.5.13 sun_body

```
LightingBody jeod::EarthLighting::sun_body
```

Sun stellar parameters.

trick_units(–)

Definition at line 205 of file earth_lighting.hh.

Referenced by calc_lighting(), and initialize().

7.1.5.14 sun_earth

```
LightingParams jeod::EarthLighting::sun_earth
```

Lighting of sun w.r.t.

vehicle.trick_units(–)

Definition at line 220 of file earth_lighting.hh.

Referenced by calc_lighting().

7.1.5.15 sun_frame

```
const RefFrame* jeod::EarthLighting::sun_frame {}
```

Pointer to the translation information for Sun inertial.

trick_units(–)

Definition at line 200 of file earth_lighting.hh.

Referenced by calc_lighting(), and initialize().

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

- earth_lighting.hh
- earth_lighting.cc

7.2 jeod::EarthLightingMessages Class Reference

Describes messages used in the earth lighting model.

```
#include <earth_lighting_messages.hh>
```

Public Member Functions

- EarthLightingMessages ()=delete
- EarthLightingMessages (const EarthLightingMessages &rhs)=delete
- EarthLightingMessages & operator= (const EarthLightingMessages &rhs)=delete

Static Public Attributes

- static const char * initialization_error = "environment/earth_lighting/" "initialization_error"

  Indicates an error during initialization.

Friends

- class InputProcessor
- void init_attrjeod__EarthLightingMessages ()

7.2.1 Detailed Description

Describes messages used in the earth lighting model.

Definition at line 83 of file earth_lighting_messages.hh.

7.2.2 Constructor & Destructor Documentation

7.2.2.1 EarthLightingMessages() [1/2]

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

7.2.2.2 EarthLightingMessages() [2/2]

```
jeod::EarthLightingMessages::EarthLightingMessages (
            const EarthLightingMessages & rhs )  [delete]
```

7.2.3 Member Function Documentation

7.2.3.1 operator=()

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

7.2.4 Friends And Related Function Documentation

7.2.4.1 init_attrjeod__EarthLightingMessages

```
void init_attrjeod__EarthLightingMessages ( )  [friend]
```

7.2.4.2 InputProcessor

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

Definition at line 85 of file earth_lighting_messages.hh.

7.2.5 Field Documentation

7.2.5.1 initialization_error

```
char const * jeod::EarthLightingMessages::initialization_error = "environment/earth_lighting/"
"initialization_error"  [static]
```

Indicates an error during initialization.

trick_units(–)

Definition at line 93 of file earth_lighting_messages.hh.

Referenced by jeod::EarthLighting::initialize().

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

- earth_lighting_messages.hh
- earth_lighting_messages.cc

7.3 jeod::LightingBody Class Reference

Represents a major source of light in a space environment, such as the sun, the Earth, the moon, etc.

```
#include <earth_lighting.hh>
```

Public Member Functions

- LightingBody ()=default
- ~LightingBody ()=default
- LightingBody & operator= (const LightingBody &)=delete
- LightingBody (const LightingBody &)=delete

Data Fields

- double radius {}

  Celestial body mean equitorial radius.
- double position [3] {}

  Inertial position relative to observer.
- double distance {}

  Distance from observer to light body.
- double half_angle {}

  Apparent half angle of body disk.

Friends

- class InputProcessor
- void init_attrjeod__LightingBody ()

7.3.1 Detailed Description

Represents a major source of light in a space environment, such as the sun, the Earth, the moon, etc.

Definition at line 82 of file earth_lighting.hh.

7.3.2 Constructor & Destructor Documentation

7.3.2.1 LightingBody() [1/2]

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

7.3.2.2 ~LightingBody()

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

7.3.2.3 LightingBody() [2/2]

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

7.3.3 Member Function Documentation

7.3.3.1 operator=()

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

7.3.4 Friends And Related Function Documentation

7.3.4.1 init_attrjeod__LightingBody

```
void init_attrjeod__LightingBody ( )  [friend]
```

7.3.4.2 InputProcessor

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

Definition at line 84 of file earth_lighting.hh.

7.3.5 Field Documentation

7.3.5.1 distance

```
double jeod::LightingBody::distance {}
```

Distance from observer to light body.

trick_units(m)

Definition at line 103 of file earth_lighting.hh.

Referenced by jeod::EarthLighting::calc_lighting().

7.3.5.2 half_angle

```
double jeod::LightingBody::half_angle {}
```

Apparent half angle of body disk.

trick_units(rad)

Definition at line 108 of file earth_lighting.hh.

Referenced by jeod::EarthLighting::calc_lighting().

7.3.5.3 position

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

Inertial position relative to observer.

trick_units(m)

Definition at line 98 of file earth_lighting.hh.

Referenced by jeod::EarthLighting::calc_lighting().

7.3.5.4 radius

```
double jeod::LightingBody::radius {}
```

Celestial body mean equitorial radius.

trick_units(m)

Definition at line 93 of file earth_lighting.hh.

Referenced by jeod::EarthLighting::calc_lighting(), and jeod::EarthLighting::initialize().

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

- earth_lighting.hh

7.4 jeod::LightingParams Class Reference

Contains important parameters for lighting information.

```
#include <earth_lighting.hh>
```

Public Member Functions

- LightingParams ()=default
- ~LightingParams ()=default
- LightingParams & operator= (const LightingParams &)=delete
- LightingParams (const LightingParams &)=delete

Data Fields

- double obs_angle {}

  Apparent observation angle from light source.
- double phase {}

  Apparent lighting phase of planet.
- double occlusion {}

  Fraction of planetary surface occlusion.
- double visible {}

  Fraction of planetary surface visible.
- double lighting {}

  Fraction of lighting (phase ∗ visible).

Friends

- class InputProcessor
- void init_attrjeod__LightingParams ()

7.4.1 Detailed Description

Contains important parameters for lighting information.

Definition at line 114 of file earth_lighting.hh.

7.4.2 Constructor & Destructor Documentation

7.4.2.1 LightingParams() [1/2]

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

7.4.2.2 ∼LightingParams()

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

7.4.2.3 LightingParams() [2/2]

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

7.4.3 Member Function Documentation

7.4.3.1 operator=()

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

7.4.4 Friends And Related Function Documentation

7.4.4.1 init_attrjeod__LightingParams

```
void init_attrjeod__LightingParams ( )  [friend]
```

7.4.4.2 InputProcessor

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

Definition at line 116 of file earth_lighting.hh.

7.4.5 Field Documentation

7.4.5.1 lighting

```
double jeod::LightingParams::lighting {}
```

Fraction of lighting (phase ∗ visible).

trick_units(–)

Definition at line 145 of file earth_lighting.hh.

Referenced by jeod::EarthLighting::calc_lighting().

7.4.5.2 obs_angle

```
double jeod::LightingParams::obs_angle {}
```

Apparent observation angle from light source.

trick_units(rad)

Definition at line 125 of file earth_lighting.hh.

Referenced by jeod::EarthLighting::calc_lighting().

7.4.5.3 occlusion

```
double jeod::LightingParams::occlusion {}
```

Fraction of planetary surface occlusion.

trick_units(–)

Definition at line 135 of file earth_lighting.hh.

Referenced by jeod::EarthLighting::calc_lighting().

7.4.5.4 phase

```
double jeod::LightingParams::phase {}
```

Apparent lighting phase of planet.

trick_units(–)

Definition at line 130 of file earth_lighting.hh.

Referenced by jeod::EarthLighting::calc_lighting().

7.4.5.5 visible

```
double jeod::LightingParams::visible {}
```

Fraction of planetary surface visible.

trick_units(–)

Definition at line 140 of file earth_lighting.hh.

Referenced by jeod::EarthLighting::calc_lighting().

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

- earth_lighting.hh

Chapter 8

File Documentation

8.1 class_declarations.hh File Reference

Forward declarations of classes defined for JEOD 2.0 Earth Lighting.

Namespaces

- jeod

  Namespace jeod.

8.1.1 Detailed Description

Forward declarations of classes defined for JEOD 2.0 Earth Lighting.

8.2 earth_lighting.cc File Reference

Implementation of the classes necessary for calculating Sun, Moon and Earth lighting effects on a vehicle orbiting the Earth.

```
#include <cmath>
#include <cstddef>
#include "dynamics/dyn_manager/include/dyn_manager.hh"
#include "environment/planet/include/planet.hh"
#include "utils/math/include/vector3.hh"
#include "utils/message/include/message_handler.hh"
#include "../include/earth_lighting.hh"
#include "../include/earth_lighting_messages.hh"
```

Namespaces

- jeod

  Namespace jeod.

Variables

- static constexpr double jeod::epsilon = 1.0e-12

8.2.1 Detailed Description

Implementation of the classes necessary for calculating Sun, Moon and Earth lighting effects on a vehicle orbiting the Earth.

8.3 earth_lighting.hh File Reference

Calculates lighting information from the Earth, Sun and Moon for a vehicle in low Earth orbit.

```
#include "dynamics/dyn_manager/include/class_declarations.hh"
#include "environment/planet/include/class_declarations.hh"
#include "utils/ref_frames/include/class_declarations.hh"
#include "utils/sim_interface/include/jeod_class.hh"
#include "environment/planet/include/planet.hh"
#include "utils/ref_frames/include/ref_frame.hh"
```

Data Structures

- class jeod::LightingBody

  Represents a major source of light in a space environment, such as the sun, the Earth, the moon, etc.
- class jeod::LightingParams

  Contains important parameters for lighting information.
- class jeod::EarthLighting

  A class for calculating lighting effects in low Earth orbit.

Namespaces

- jeod

  Namespace jeod.

8.3.1 Detailed Description

Calculates lighting information from the Earth, Sun and Moon for a vehicle in low Earth orbit.

8.4 earth_lighting_messages.cc File Reference

Implement earth_lighting_messages.

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

Namespaces

- jeod

  Namespace jeod.

Macros

- #define MAKE_EARTHLIGHTING_MESSAGE_CODE(id) JEOD_MAKE_MESSAGE_CODE(Earth↩ LightingMessages, "environment/earth_lighting/", id)

8.4.1 Detailed Description

Implement earth_lighting_messages.

8.4.2 Macro Definition Documentation

8.4.2.1 MAKE_EARTHLIGHTING_MESSAGE_CODE

```
#define MAKE_EARTHLIGHTING_MESSAGE_CODE(
              id ) JEOD_MAKE_MESSAGE_CODE(EarthLightingMessages, "environment/earth_lighting/",
id)
```

Definition at line 43 of file earth_lighting_messages.cc.

8.5 earth_lighting_messages.hh File Reference

Implement earth_lighting_messages.

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

Data Structures

- class jeod::EarthLightingMessages

  Describes messages used in the earth lighting model.

Namespaces

- jeod

  Namespace jeod.

8.5.1 Detailed Description

Implement earth_lighting_messages.

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