

# Tspeed

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# Chapter 1

## Namespace Index

### 1.1 Namespace List

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## Chapter 2

# Hierarchical Index

### 2.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

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Tspeed::Force . . . . .	21
Tspeed::PointWiseForce . . . . .	35
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Tspeed::Matrices . . . . .	24
Tspeed::Mesh . . . . .	25
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Tspeed::Dubiner< N > . . . . .	16
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## Chapter 3

# Class Index

### 3.1 Class List

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## Chapter 4

# File Index

### 4.1 File List

Here is a list of all files with brief descriptions:

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## Chapter 5

# Namespace Documentation

### 5.1 Tspeed Namespace Reference

#### Namespaces

- namespace [Geo](#)

#### Classes

- class [FESpace](#)
- class [Parameters](#)
- class [Force](#)
- class [PointWiseForce](#)
- class [Entity](#)
- class [Mesh](#)
- class [BaseMat](#)
- class [MyMatBlockDiag](#)
- class [MyMat](#)
- class [MyMatMultiDim](#)
- class [MyMatMultiDimBlockDiag](#)
- class **QuadratureRule**
- class [Gauss](#)
- class [Dunavant](#)
- class [PointWiseEntity](#)
- class [Receivers](#)
- class [ShapeFunction](#)
- class [Dubiner](#)
- class [BoundaryAdapted](#)
- class [Matrices](#)
- class [TimeAdvance](#)
- class [LeapFrog](#)

#### Typedefs

- `template<int N, typename Q = Gauss<N+1>, typename S = Dubiner<N>>  
using FESpace\_ptr = std::shared_ptr< FESpace< N, Q, S >>`
- `typedef std::shared_ptr< Mesh > Mesh\_ptr`

## Enumerations

- enum [Bc](#) { [Dirichlet](#), [Neumann](#), [Internal](#), [Unassigned](#) }

## Functions

- [MyMat operator\\*](#) (double const &c, [MyMat](#) const &M)
- Eigen::VectorXd [operator\\*](#) ([MyMat](#) const &, Eigen::VectorXd const &)
- Eigen::VectorXd [operator\\*](#) ([MyMatBlockDiag](#) const &, Eigen::VectorXd const &)
- [MyMat operator+](#) ([MyMat](#) a, [MyMat](#) const &b)
- [MyMat operator+](#) ([MyMat](#) a, [MyMatBlockDiag](#) const &b)
- template<int N>  
constexpr int [dunavant\\_num\\_points](#) ()
- Eigen::ArrayXd [jacobi\\_polynomial](#) (int N, int alpha, int beta, Eigen::ArrayXd const &z)
- double [mat\\_dot](#) (Eigen::Matrix2d const &a, Eigen::Matrix2d const &b)
- Eigen::Matrix2d [CTensorProduct](#) (Eigen::Matrix2d const &A, double lambda, double mu)
- Eigen::VectorXd [operator\\*](#) ([MyMatMultiDimBlockDiag](#)< [MyMatBlockDiag](#) > const &A, Eigen::VectorXd const &v)
- Eigen::VectorXd [operator\\*](#) ([MyMatMultiDim](#)< [MyMat](#) > &A, Eigen::VectorXd const &v)
- Eigen::VectorXd [operator\\*](#) ([MyMatMultiDim](#)< [MyMatBlockDiag](#) > &A, Eigen::VectorXd const &v)
- [MyMatMultiDim](#)< [MyMat](#) > [operator+](#) ([MyMatMultiDim](#)< [MyMat](#) > const &a, [MyMatMultiDim](#)< [MyMat](#) > const &b)
- [MyMatMultiDim](#)< [MyMat](#) > [operator+](#) ([MyMatMultiDim](#)< [MyMat](#) > const &a, [MyMatMultiDim](#)< [MyMatBlockDiag](#) > const &b)
- [MyMat operator+](#) ([MyMatBlockDiag](#) const &b, [MyMat](#) a)

### 5.1.1 Typedef Documentation

5.1.1.1 template<int N, typename Q = Gauss<N+1>, typename S = Dubiner<N>> using [Tspeed::FESpace\\_ptr](#) = typedef std::shared\_ptr<[FESpace](#)<N,Q,S>>

5.1.1.2 typedef std::shared\_ptr<[Mesh](#)> [Tspeed::Mesh\\_ptr](#)

### 5.1.2 Enumeration Type Documentation

5.1.2.1 enum [Tspeed::Bc](#)

Enumerator

***Dirichlet***

***Neumann***

***Internal***

***Unassigned***

### 5.1.3 Function Documentation

5.1.3.1 Eigen::Matrix2d [Tspeed::CTensorProduct](#) ( Eigen::Matrix2d const & A, double *lambda*, double *mu* )

5.1.3.2 template<int N> constexpr int [Tspeed::dunavant\\_num\\_points](#) ( )

5.1.3.3 Eigen::ArrayXd [Tspeed::jacobi\\_polynomial](#) ( int N, int *alpha*, int *beta*, Eigen::ArrayXd const & z )

5.1.3.4 double [Tspeed::mat\\_dot](#) ( Eigen::Matrix2d const & a, Eigen::Matrix2d const & b )

- 5.1.3.5 `Eigen::VectorXd Tspeed::operator* ( MyMatMultiDimBlockDiag< MyMatBlockDiag > const & A, Eigen::VectorXd const & v )`
- 5.1.3.6 `Eigen::VectorXd Tspeed::operator* ( MyMatMultiDim< MyMat > & A, Eigen::VectorXd const & v )`
- 5.1.3.7 `MyMat Tspeed::operator* ( double const & c, MyMat const & M )`
- 5.1.3.8 `Eigen::VectorXd Tspeed::operator* ( MyMat const & A, Eigen::VectorXd const & x )`
- 5.1.3.9 `Eigen::VectorXd Tspeed::operator* ( MyMatBlockDiag const & A, Eigen::VectorXd const & x )`
- 5.1.3.10 `Eigen::VectorXd Tspeed::operator* ( MyMatMultiDim< MyMatBlockDiag > & A, Eigen::VectorXd const & v )`
- 5.1.3.11 `MyMat Tspeed::operator+ ( MyMat a, MyMat const & b )`
- 5.1.3.12 `MyMat Tspeed::operator+ ( MyMat a, MyMatBlockDiag const & b )`
- 5.1.3.13 `MyMatMultiDim<MyMat> Tspeed::operator+ ( MyMatMultiDim< MyMat > const & a, MyMatMultiDim< MyMat > const & b )`
- 5.1.3.14 `MyMatMultiDim<MyMat> Tspeed::operator+ ( MyMatMultiDim< MyMat > const & a, MyMatMultiDim< MyMatBlockDiag > const & b )`
- 5.1.3.15 `MyMat Tspeed::operator+ ( MyMatBlockDiag const & b, MyMat a )`

## 5.2 Tspeed::Geo Namespace Reference

### Classes

- class [Point](#)
- class [Edge](#)
- class [Triangle](#)

### Functions

- `std::ostream & operator<< (std::ostream &, Triangle const &)`
- `std::ostream & operator<< (std::ostream &, Point const &)`
- `Point operator- (const Point &a, const Point &b)`
- `Point operator- (const Eigen::Vector2d &a, const Point &b)`
- `Point operator- (const Point &a, const Eigen::Vector2d &b)`
- `Point operator+ (const Eigen::Vector2d &a, const Point &b)`
- `Point operator+ (const Point &a, const Eigen::Vector2d &b)`
- `Point operator+ (const Point &a, const Point &b)`
- `Point operator\* (const double &d, const Point &p)`

### 5.2.1 Function Documentation

- 5.2.1.1 `Point Tspeed::Geo::operator* ( const double & d, const Point & p )`
- 5.2.1.2 `Point Tspeed::Geo::operator+ ( const Eigen::Vector2d & a, const Point & b )`
- 5.2.1.3 `Point Tspeed::Geo::operator+ ( const Point & a, const Eigen::Vector2d & b )`

5.2.1.4 **Point** Tspeed::Geo::operator+ ( const Point & *a*, const Point & *b* )

5.2.1.5 **Point** Tspeed::Geo::operator- ( const Point & *a*, const Point & *b* )

5.2.1.6 **Point** Tspeed::Geo::operator- ( const Eigen::Vector2d & *a*, const Point & *b* )

5.2.1.7 **Point** Tspeed::Geo::operator- ( const Point & *a*, const Eigen::Vector2d & *b* )

5.2.1.8 std::ostream & Tspeed::Geo::operator<< ( std::ostream & *io*, Triangle const & *t* )

5.2.1.9 std::ostream & Tspeed::Geo::operator<< ( std::ostream & *io*, Point const & *p* )



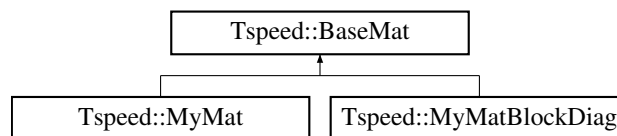
## Chapter 6

# Class Documentation

### 6.1 Tspeed::BaseMat Class Reference

```
#include <MyMat.hpp>
```

Inheritance diagram for Tspeed::BaseMat:



#### Public Member Functions

- [BaseMat \(\)](#)
- [BaseMat \(Mesh\\_ptr, unsigned int nln\)](#)
- [Eigen::MatrixXd const & block \(unsigned int i, unsigned int j\) const](#)
- [Eigen::MatrixXd & block \(unsigned int i, unsigned int j\)](#)
- [void setblock \(unsigned int i, unsigned int j, Eigen::MatrixXd const &M\)](#)
- [BaseMat \(BaseMat const &\)](#)
- [virtual ~BaseMat \(\)=default](#)
- [unsigned int nr \(\) const](#)
- [std::vector< unsigned int > const & rowInd \(\) const](#)
- [std::vector< unsigned int > const & colInd \(\) const](#)
- [void set\\_rowInd \(std::vector< unsigned int >const &v\)](#)
- [void set\\_colInd \(std::vector< unsigned int >const &v\)](#)
- [std::vector< Eigen::MatrixXd > const & elem \(\) const](#)
- [std::vector< Eigen::MatrixXd > & elem \(\)](#)
- [Eigen::MatrixXd const & elem \(int i\) const](#)
- [unsigned int size \(\) const](#)
- [void vecMult \(Eigen::VectorXd const &, Eigen::VectorXd &\) const](#)

#### Protected Attributes

- unsigned int [M\\_nr](#)
- unsigned int [M\\_nc](#)
- unsigned int [M\\_nln](#)

- `std::vector< Eigen::MatrixXd > M_m`
- `std::vector< unsigned int > M_r`
- `std::vector< unsigned int > M_c`

### 6.1.1 Constructor & Destructor Documentation

6.1.1.1 `Tspeed::BaseMat::BaseMat ( )`

6.1.1.2 `Tspeed::BaseMat::BaseMat ( Mesh_ptr , unsigned int n/n )`

6.1.1.3 `Tspeed::BaseMat::BaseMat ( BaseMat const & )`

6.1.1.4 `virtual Tspeed::BaseMat::~~BaseMat ( )` `[virtual]`, `[default]`

### 6.1.2 Member Function Documentation

6.1.2.1 `Eigen::MatrixXd const & Tspeed::BaseMat::block ( unsigned int i, unsigned int j ) const`

6.1.2.2 `Eigen::MatrixXd & Tspeed::BaseMat::block ( unsigned int i, unsigned int j )`

6.1.2.3 `std::vector<unsigned int> const& Tspeed::BaseMat::colInd ( ) const` `[inline]`

6.1.2.4 `std::vector<Eigen::MatrixXd> const& Tspeed::BaseMat::elem ( ) const` `[inline]`

6.1.2.5 `std::vector<Eigen::MatrixXd>& Tspeed::BaseMat::elem ( )` `[inline]`

6.1.2.6 `Eigen::MatrixXd const& Tspeed::BaseMat::elem ( int i ) const` `[inline]`

6.1.2.7 `unsigned int Tspeed::BaseMat::nr ( ) const` `[inline]`

6.1.2.8 `std::vector<unsigned int> const& Tspeed::BaseMat::rowInd ( ) const` `[inline]`

6.1.2.9 `void Tspeed::BaseMat::set_colInd ( std::vector< unsigned int >const & v )` `[inline]`

6.1.2.10 `void Tspeed::BaseMat::set_rowInd ( std::vector< unsigned int >const & v )` `[inline]`

6.1.2.11 `void Tspeed::BaseMat::setblock ( unsigned int i, unsigned int j, Eigen::MatrixXd const & M )`

6.1.2.12 `unsigned int Tspeed::BaseMat::size ( ) const` `[inline]`

6.1.2.13 `void Tspeed::BaseMat::vecMult ( Eigen::VectorXd const & x, Eigen::VectorXd & out ) const`

### 6.1.3 Member Data Documentation

6.1.3.1 `std::vector<unsigned int> Tspeed::BaseMat::M_c` `[protected]`

6.1.3.2 `std::vector<Eigen::MatrixXd> Tspeed::BaseMat::M_m` `[protected]`

6.1.3.3 `unsigned int Tspeed::BaseMat::M_nc` `[protected]`

6.1.3.4 `unsigned int Tspeed::BaseMat::M_nln` `[protected]`

6.1.3.5 `unsigned int Tspeed::BaseMat::M_nr` `[protected]`

6.1.3.6 `std::vector<unsigned int> Tspeed::BaseMat::M_r` [protected]

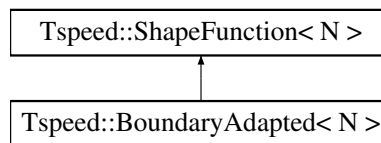
The documentation for this class was generated from the following files:

- [lib/include/MyMat.hpp](#)
- [lib/src/MyMat.cpp](#)

## 6.2 Tspeed::BoundaryAdapted< N > Class Template Reference

```
#include <ShapeFunctions.hpp>
```

Inheritance diagram for Tspeed::BoundaryAdapted< N >:



### Public Types

- enum { `is_orthonormal` = false }

### Public Member Functions

- virtual `~BoundaryAdapted` ()
- `BoundaryAdapted` ()

### Additional Inherited Members

#### 6.2.1 Member Enumeration Documentation

6.2.1.1 `template<int N> anonymous enum`

Enumerator

***is\_orthonormal***

#### 6.2.2 Constructor & Destructor Documentation

6.2.2.1 `template<int N> virtual Tspeed::BoundaryAdapted< N >::~BoundaryAdapted ( )` [inline], [virtual]

6.2.2.2 `template<int N> Tspeed::BoundaryAdapted< N >::BoundaryAdapted ( )`

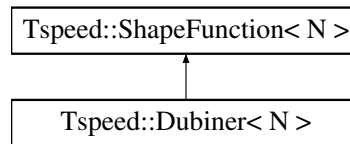
The documentation for this class was generated from the following files:

- [lib/include/ShapeFunctions.hpp](#)
- [lib/include/ShapeFunctions\\_imp.hpp](#)

### 6.3 Tspeed::Dubiner< N > Class Template Reference

```
#include <ShapeFunctions.hpp>
```

Inheritance diagram for Tspeed::Dubiner< N >:



#### Public Types

- enum { [is\\_orthonormal](#) = true }

#### Public Member Functions

- virtual [~Dubiner](#) ()
- [Dubiner](#) ()

#### Additional Inherited Members

##### 6.3.1 Member Enumeration Documentation

###### 6.3.1.1 template<int N> anonymous enum

Enumerator

***is\_orthonormal***

##### 6.3.2 Constructor & Destructor Documentation

###### 6.3.2.1 template<int N> virtual Tspeed::Dubiner< N >::~~Dubiner ( ) [inline],[virtual]

###### 6.3.2.2 template<int N> Tspeed::Dubiner< N >::Dubiner ( )

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

- lib/include/[ShapeFunctions.hpp](#)
- lib/include/[ShapeFunctions\\_imp.hpp](#)

### 6.4 Tspeed::Dunavant< N > Class Template Reference

```
#include <QuadratureRule.hpp>
```

Inherits Tspeed::QuadratureRule< N >.

#### Public Types

- enum { [nqn2d](#) = dunavant\_num\_points<N>() }
- enum { [nqn1d](#) = N }

- typedef QuadratureRule< N >::Vec [Vec](#)
- typedef QuadratureRule< N >::Vec [Mat](#)
- typedef QuadratureRule< N >::Vec [Vec2](#)

## Public Member Functions

- [Dunavant](#) ()

## Additional Inherited Members

### 6.4.1 Member Typedef Documentation

6.4.1.1 `template<int N> typedef QuadratureRule<N>::Vec Tspeed::Dunavant< N >::Mat`

6.4.1.2 `template<int N> typedef QuadratureRule<N>::Vec Tspeed::Dunavant< N >::Vec`

6.4.1.3 `template<int N> typedef QuadratureRule<N>::Vec Tspeed::Dunavant< N >::Vec2`

### 6.4.2 Member Enumeration Documentation

6.4.2.1 `template<int N> anonymous enum`

Enumerator

***nqn2d***

6.4.2.2 `template<int N> anonymous enum`

Enumerator

***nqn1d***

### 6.4.3 Constructor & Destructor Documentation

6.4.3.1 `template<int N> Tspeed::Dunavant< N >::Dunavant ( )`

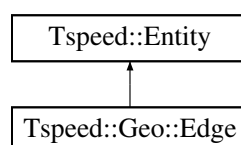
The documentation for this class was generated from the following files:

- lib/include/[QuadratureRule.hpp](#)
- lib/include/[QuadratureRule\\_imp.hpp](#)

## 6.5 Tspeed::Geo::Edge Class Reference

```
#include <Geometry.hpp>
```

Inheritance diagram for Tspeed::Geo::Edge:



## Public Member Functions

- [Edge](#) ()
- [Edge](#) (const [Point](#) &a, const [Point](#) &b)
- [Edge](#) (const [Edge](#) &e)
- virtual [~Edge](#) ()
- double [length](#) () const
- [Eigen::Vector2d](#) [normal](#) () const
- [Edge](#) & [operator=](#) (const [Edge](#) &)

## Additional Inherited Members

### 6.5.1 Constructor & Destructor Documentation

6.5.1.1 `Tspeed::Geo::Edge::Edge ( )` [\[inline\]](#)

6.5.1.2 `Tspeed::Geo::Edge::Edge ( const Point & a, const Point & b )` [\[inline\]](#)

6.5.1.3 `Tspeed::Geo::Edge::Edge ( const Edge & e )` [\[inline\]](#)

6.5.1.4 `virtual Tspeed::Geo::Edge::~~Edge ( )` [\[inline\]](#), [\[virtual\]](#)

### 6.5.2 Member Function Documentation

6.5.2.1 `double Tspeed::Geo::Edge::length ( )` const [\[inline\]](#)

6.5.2.2 `Eigen::Vector2d Tspeed::Geo::Edge::normal ( )` const

6.5.2.3 `Edge & Tspeed::Geo::Edge::operator= ( const Edge & e )`

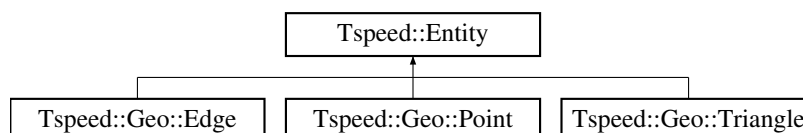
The documentation for this class was generated from the following files:

- [lib/include/Geometry.hpp](#)
- [lib/src/Geometry.cpp](#)

## 6.6 Tspeed::Entity Class Reference

```
#include <Geometry.hpp>
```

Inheritance diagram for `Tspeed::Entity`:



## Public Types

- typedef unsigned int [ld](#)

## Public Member Functions

- [Entity](#) ()
- bool [unassignedId](#) () const
- bool [unassignedBc](#) () const
- bool [unassignedReg](#) () const
- [Id](#) & [reg](#) ()
- [Id](#) const & [reg](#) () const
- [Id](#) & [id](#) ()
- [Id](#) const & [id](#) () const
- [Bc](#) & [bcId](#) ()
- [Bc](#) const & [bcId](#) () const

## Protected Attributes

- [Id](#) [M\\_reg](#)
- [Id](#) [M\\_id](#)
- [Bc](#) [M\\_bcId](#)

### 6.6.1 Member Typedef Documentation

6.6.1.1 `typedef unsigned int Tspeed::Entity::Id`

### 6.6.2 Constructor & Destructor Documentation

6.6.2.1 `Tspeed::Entity::Entity ( )` `[inline]`

### 6.6.3 Member Function Documentation

6.6.3.1 `Bc& Tspeed::Entity::bcId ( )` `[inline]`

6.6.3.2 `Bc const& Tspeed::Entity::bcId ( ) const` `[inline]`

6.6.3.3 `Id& Tspeed::Entity::id ( )` `[inline]`

6.6.3.4 `Id const& Tspeed::Entity::id ( ) const` `[inline]`

6.6.3.5 `Id& Tspeed::Entity::reg ( )` `[inline]`

6.6.3.6 `Id const& Tspeed::Entity::reg ( ) const` `[inline]`

6.6.3.7 `bool Tspeed::Entity::unassignedBc ( ) const` `[inline]`

6.6.3.8 `bool Tspeed::Entity::unassignedId ( ) const` `[inline]`

6.6.3.9 `bool Tspeed::Entity::unassignedReg ( ) const` `[inline]`

### 6.6.4 Member Data Documentation

6.6.4.1 `Bc Tspeed::Entity::M_bcId` `[protected]`

6.6.4.2 `Id Tspeed::Entity::M_id` `[protected]`

#### 6.6.4.3 Id Tspeed::Entity::M\_reg [protected]

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

- lib/include/Geometry.hpp

## 6.7 Tspeed::FESpace< N, Q, S > Class Template Reference

```
#include <FESpace.hpp>
```

### Public Member Functions

- [FESpace](#) ([Mesh\\_ptr](#))
- virtual [~FESpace](#) ()
- [Mesh\\_ptr](#) [mesh](#) () const
- [Q](#) const & [quad](#) () const
- [ShapeFunction](#)< [N](#) > const & [shape](#) () const
- unsigned int [nln](#) () const
- unsigned int [ne](#) () const
- [Eigen::Vector2d](#) [grad](#) (unsigned int [k](#), unsigned int [i](#)) const
- [Eigen::VectorXd](#) [b\\_edge](#) (unsigned int [k](#), unsigned int [iedg](#)) const
- [Eigen::Vector2d](#) [g\\_edge](#) (unsigned int [k](#), unsigned int [i](#), unsigned short int [edg](#)) const
- [Eigen::VectorXd](#) [inverse\\_transform](#) ([std::function](#)< [std::array](#)< double, 2 >(double, double)> const &) const
- double [L2error](#) ([std::function](#)< [std::array](#)< double, 2 >(double, double)> const &, [Eigen::VectorXd](#) const &) const
- [Eigen::VectorXd](#) [loc\\_rhs](#) ([Geo::Triangle](#) const &[ie](#), [std::function](#)< [std::array](#)< double, 2 >(double, double)> const &[fun](#)) const
- void [points\\_out](#) ([std::string](#) const &[fname](#)) const
- void [field\\_out](#) ([std::string](#) const &[fname](#), [Eigen::VectorXd](#) const &[uh](#), unsigned int [step](#)) const

### Public Attributes

- [EIGEN\\_MAKE\\_ALIGNED\\_OPERATOR\\_NEW](#)

### 6.7.1 Constructor & Destructor Documentation

6.7.1.1 `template<int N, typename Q, typename S > Tspeed::FESpace< N, Q, S >::FESpace ( Mesh\_ptr m )`  
[explicit]

6.7.1.2 `template<int N, typename Q = Gauss<N+1>, typename S = Dubiner<N>> virtual Tspeed::FESpace< N, Q, S >::~~FESpace ( )` [inline], [virtual]

### 6.7.2 Member Function Documentation

6.7.2.1 `template<int N, typename Q = Gauss<N+1>, typename S = Dubiner<N>> Eigen::VectorXd Tspeed::FESpace< N, Q, S >::b_edge ( unsigned int k, unsigned int iedg ) const` [inline]

6.7.2.2 `template<int N, typename Q, typename S > void Tspeed::FESpace< N, Q, S >::field_out ( std::string const & fname, Eigen::VectorXd const & uh, unsigned int step ) const`

6.7.2.3 `template<int N, typename Q = Gauss<N+1>, typename S = Dubiner<N>> Eigen::Vector2d Tspeed::FESpace< N, Q, S >::g_edge ( unsigned int k, unsigned int i, unsigned short int edg ) const` [inline]



- 6.7.2.4 `template<int N, typename Q = Gauss<N+1>, typename S = Dubiner<N>> Eigen::Vector2d Tspeed::FESpace< N, Q, S >::grad ( unsigned int k, unsigned int i ) const [inline]`
- 6.7.2.5 `template<int N, typename Q , typename S > Eigen::VectorXd Tspeed::FESpace< N, Q, S >::inverse_transform ( std::function< std::array< double, 2 >(double, double)> const & fun ) const`
- 6.7.2.6 `template<int N, typename Q , typename S > double Tspeed::FESpace< N, Q, S >::L2error ( std::function< std::array< double, 2 >(double, double)> const & uex, Eigen::VectorXd const & uh ) const`
- 6.7.2.7 `template<int N, typename Q = Gauss<N+1>, typename S = Dubiner<N>> Eigen::VectorXd Tspeed::FESpace< N, Q, S >::loc_rhs ( Geo::Triangle const & ie, std::function< std::array< double, 2 >(double, double)> const & fun ) const [inline]`
- 6.7.2.8 `template<int N, typename Q = Gauss<N+1>, typename S = Dubiner<N>> Mesh_ptr Tspeed::FESpace< N, Q, S >::mesh ( ) const [inline]`
- 6.7.2.9 `template<int N, typename Q = Gauss<N+1>, typename S = Dubiner<N>> unsigned int Tspeed::FESpace< N, Q, S >::ne ( ) const [inline]`
- 6.7.2.10 `template<int N, typename Q = Gauss<N+1>, typename S = Dubiner<N>> unsigned int Tspeed::FESpace< N, Q, S >::nln ( ) const [inline]`
- 6.7.2.11 `template<int N, typename Q , typename S > void Tspeed::FESpace< N, Q, S >::points_out ( std::string const & fname ) const`
- 6.7.2.12 `template<int N, typename Q = Gauss<N+1>, typename S = Dubiner<N>> Q const& Tspeed::FESpace< N, Q, S >::quad ( ) const [inline]`
- 6.7.2.13 `template<int N, typename Q = Gauss<N+1>, typename S = Dubiner<N>> ShapeFunction<N> const& Tspeed::FESpace< N, Q, S >::shape ( ) const [inline]`

### 6.7.3 Member Data Documentation

- 6.7.3.1 `template<int N, typename Q = Gauss<N+1>, typename S = Dubiner<N>> Tspeed::FESpace< N, Q, S >::EIGEN_MAKE_ALIGNED_OPERATOR_NEW`

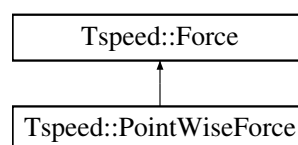
The documentation for this class was generated from the following files:

- [lib/include/FESpace.hpp](#)
- [lib/include/FESpace\\_imp.hpp](#)

## 6.8 Tspeed::Force Class Reference

```
#include <Force.hpp>
```

Inheritance diagram for Tspeed::Force:



## Public Types

- typedef Eigen::SparseVector  
< double > [SPVec](#)
- typedef Eigen::VectorXd [Vec](#)

## Public Member Functions

- [Force](#) ()
- [Force](#) (std::function< std::array< double, 2 >(const double &)> const &)
- virtual [~Force](#) ()
- virtual [Vec eval](#) (const double &) const =0

## Protected Attributes

- std::function< std::array  
< double, 2 >const double &)> [M\\_f](#)

### 6.8.1 Member Typedef Documentation

6.8.1.1 typedef Eigen::SparseVector<double> [Tspeed::Force::SPVec](#)

6.8.1.2 typedef Eigen::VectorXd [Tspeed::Force::Vec](#)

### 6.8.2 Constructor & Destructor Documentation

6.8.2.1 [Tspeed::Force::Force](#) ( ) [inline]

6.8.2.2 [Tspeed::Force::Force](#) ( std::function< std::array< double, 2 >(const double &)> const & )

6.8.2.3 virtual [Tspeed::Force::~~Force](#) ( ) [inline],[virtual]

### 6.8.3 Member Function Documentation

6.8.3.1 virtual [Vec](#) [Tspeed::Force::eval](#) ( const double & ) const [pure virtual]

Implemented in [Tspeed::PointWiseForce](#).

### 6.8.4 Member Data Documentation

6.8.4.1 std::function<std::array<double,2>const double &)> [Tspeed::Force::M\\_f](#) [protected]

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

- lib/include/[Force.hpp](#)

## 6.9 [Tspeed::Gauss](#)< N > Class Template Reference

```
#include <QuadratureRule.hpp>
```

Inherits [Tspeed::QuadratureRule](#)< N >.

## Public Types

- enum { [nqn2d](#) = N\*N }
- enum { [nqn1d](#) = N }
- typedef QuadratureRule< N >::Vec [Vec](#)
- typedef QuadratureRule< N >::Vec [Mat](#)
- typedef QuadratureRule< N >::Vec [Vec2](#)

## Public Member Functions

- [Gauss](#) ()

## Additional Inherited Members

### 6.9.1 Member Typedef Documentation

6.9.1.1 `template<int N> typedef QuadratureRule<N>::Vec Tspeed::Gauss< N >::Mat`

6.9.1.2 `template<int N> typedef QuadratureRule<N>::Vec Tspeed::Gauss< N >::Vec`

6.9.1.3 `template<int N> typedef QuadratureRule<N>::Vec Tspeed::Gauss< N >::Vec2`

### 6.9.2 Member Enumeration Documentation

6.9.2.1 `template<int N> anonymous enum`

Enumerator

***nqn2d***

6.9.2.2 `template<int N> anonymous enum`

Enumerator

***nqn1d***

### 6.9.3 Constructor & Destructor Documentation

6.9.3.1 `template<int N> Tspeed::Gauss< N >::Gauss ( )`

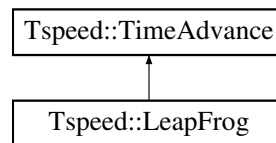
The documentation for this class was generated from the following files:

- lib/include/[QuadratureRule.hpp](#)
- lib/include/[QuadratureRule\\_imp.hpp](#)

## 6.10 Tspeed::LeapFrog Class Reference

```
#include <TimeAdvance.hpp>
```

Inheritance diagram for Tspeed::LeapFrog:



## Public Member Functions

- `template<int N, typename Q, typename S >`  
`LeapFrog (FESpace_ptr< N, Q, S >, Parameters const &, Receivers const &)`
- `void first_step ()`
- `void step (double)`

## Additional Inherited Members

### 6.10.1 Constructor & Destructor Documentation

- 6.10.1.1 `template<int N, typename Q, typename S > Tspeed::LeapFrog::LeapFrog ( FESpace_ptr< N, Q, S > Xh, Parameters const & p, Receivers const & r )`

### 6.10.2 Member Function Documentation

- 6.10.2.1 `void Tspeed::LeapFrog::first_step ( )`
- 6.10.2.2 `void Tspeed::LeapFrog::step ( double t )`

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

- `lib/include/TimeAdvance.hpp`
- `lib/include/TimeAdvance_imp.hpp`
- `lib/src/TimeAdvance.cpp`

## 6.11 Tspeed::Matrices Class Reference

```
#include <TimeAdvance.hpp>
```

## Public Types

- `typedef Eigen::SparseMatrix`  
`< double > SpMat`

## Public Member Functions

- `template<int N, typename Q, typename S >`  
`Matrices (FESpace_ptr< N, Q, S >, Parameters const &)`
- `MyMatMultiDim< MyMatBlockDiag >`  
`const & getA ()`
- `MyMatMultiDim< MyMat > const & getS ()`
- `MyMatMultiDim< MyMat > const & getI ()`
- `MyMatMultiDimBlockDiag`  
`< MyMatBlockDiag > const & getinvM ()`

- `template<int N, typename Q, typename T >`  
[Matrices](#) ([FESpace\\_ptr](#)< N, Q, T > *Xh*, [Parameters](#) const &P)

### 6.11.1 Member Typedef Documentation

- 6.11.1.1 `typedef Eigen::SparseMatrix<double> Tspeed::Matrices::SpMat`

### 6.11.2 Constructor & Destructor Documentation

- 6.11.2.1 `template<int N, typename Q, typename S > Tspeed::Matrices::Matrices ( FESpace\_ptr< N, Q, S >, Parameters const & )`
- 6.11.2.2 `template<int N, typename Q, typename T > Tspeed::Matrices::Matrices ( FESpace\_ptr< N, Q, T > Xh, Parameters const & P )`

### 6.11.3 Member Function Documentation

- 6.11.3.1 `MyMatMultiDim<MyMatBlockDiag> const& Tspeed::Matrices::getA ( ) [inline]`
- 6.11.3.2 `MyMatMultiDim<MyMat> const& Tspeed::Matrices::getI ( ) [inline]`
- 6.11.3.3 `MyMatMultiDimBlockDiag<MyMatBlockDiag> const& Tspeed::Matrices::getinvM ( ) [inline]`
- 6.11.3.4 `MyMatMultiDim<MyMat> const& Tspeed::Matrices::getS ( ) [inline]`

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

- [lib/include/TimeAdvance.hpp](#)
- [lib/include/Matrices\\_imp.hpp](#)

## 6.12 Tspeed::Mesh Class Reference

```
#include <Mesh.hpp>
```

### Public Types

- `typedef unsigned int size\_type`
- `typedef std::vector`  
`< Geo::Triangle,`  
`Eigen::aligned_allocator`  
`< Eigen::Vector2d > > AlignedVecT`
- `typedef std::vector< Geo::Edge,`  
`Eigen::aligned_allocator`  
`< Eigen::Vector2d > > AlignedVecE`
- `typedef std::vector`  
`< Geo::Point,`  
`Eigen::aligned_allocator`  
`< Eigen::Vector2d > > AlignedVecP`

### Public Member Functions

- [Mesh](#) (const std::string)
- [Geo::Triangle](#) const & [operator\[\]](#) (size\_t i) const

- [Geo::Triangle](#) & [operator\[\]](#) (size\_t i)
- [AlignedVecT](#) const & [elements](#) () const
- [AlignedVecT](#) & [elements](#) ()
- [~Mesh](#) ()
- void [stats](#) () const
- unsigned int [ne](#) () const
- void [printallNeigh](#) () const

## Public Attributes

- std::vector< std::pair  
     < unsigned int, unsigned int > > [M\\_bed\\_map](#)

## 6.12.1 Member Typedef Documentation

6.12.1.1 `typedef std::vector<Geo::Edge,Eigen::aligned_allocator<Eigen::Vector2d> > Tspeed::Mesh::AlignedVecE`

6.12.1.2 `typedef std::vector<Geo::Point,Eigen::aligned_allocator<Eigen::Vector2d> > Tspeed::Mesh::AlignedVecP`

6.12.1.3 `typedef std::vector<Geo::Triangle,Eigen::aligned_allocator<Eigen::Vector2d> >  
 Tspeed::Mesh::AlignedVecT`

6.12.1.4 `typedef unsigned int Tspeed::Mesh::size_type`

## 6.12.2 Constructor & Destructor Documentation

6.12.2.1 `Tspeed::Mesh::Mesh ( const std::string fileName ) [explicit]`

6.12.2.2 `Tspeed::Mesh::~~Mesh ( ) [inline]`

## 6.12.3 Member Function Documentation

6.12.3.1 `AlignedVecT const& Tspeed::Mesh::elements ( ) const [inline]`

6.12.3.2 `AlignedVecT& Tspeed::Mesh::elements ( ) [inline]`

6.12.3.3 `unsigned int Tspeed::Mesh::ne ( ) const [inline]`

6.12.3.4 `Geo::Triangle const& Tspeed::Mesh::operator[] ( size_t i ) const [inline]`

6.12.3.5 `Geo::Triangle& Tspeed::Mesh::operator[] ( size_t i ) [inline]`

6.12.3.6 `void Tspeed::Mesh::printallNeigh ( ) const [inline]`

6.12.3.7 `void Tspeed::Mesh::stats ( ) const`

## 6.12.4 Member Data Documentation

6.12.4.1 `std::vector<std::pair<unsigned int,unsigned int> > Tspeed::Mesh::M_bed_map`

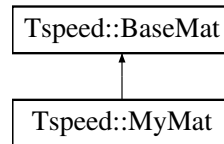
The documentation for this class was generated from the following files:

- [lib/include/Mesh.hpp](#)
- [lib/src/Mesh.cpp](#)

## 6.13 Tspeed::MyMat Class Reference

```
#include <MyMat.hpp>
```

Inheritance diagram for Tspeed::MyMat:



### Public Member Functions

- [MyMat](#) ()
- [MyMat](#) ([Mesh\\_ptr](#), unsigned int *nln*)
- [MyMat](#) ([MyMat](#) &&)=default
- [MyMat](#) ([MyMat](#) const &)
- [MyMat](#) & [operator=](#) ([MyMat](#) &&)=default
- [MyMat](#) & [operator=](#) ([MyMat](#) const &)=default
- virtual [~MyMat](#) () noexcept(true)=default
- void [symmetrize](#) ()
- void [sumtranspose](#) ([MyMat](#) const &)
- [MyMat](#) [operator+=](#) ([MyMat](#) const &)
- [MyMat](#) [operator+=](#) ([MyMatBlockDiag](#) const &)
- [MyMat](#) [operator\\*](#) (double const &) const

### Additional Inherited Members

#### 6.13.1 Constructor & Destructor Documentation

6.13.1.1 `Tspeed::MyMat::MyMat ( )` [inline]

6.13.1.2 `Tspeed::MyMat::MyMat ( Mesh_ptr Th, unsigned int nln )`

6.13.1.3 `Tspeed::MyMat::MyMat ( MyMat && )` [default]

6.13.1.4 `Tspeed::MyMat::MyMat ( MyMat const & m )`

6.13.1.5 `virtual Tspeed::MyMat::~~MyMat ( )` [virtual],[default],[noexcept]

#### 6.13.2 Member Function Documentation

6.13.2.1 `MyMat Tspeed::MyMat::operator* ( double const & c ) const`

6.13.2.2 `MyMat Tspeed::MyMat::operator+= ( MyMat const & a )`

6.13.2.3 `MyMat Tspeed::MyMat::operator+= ( MyMatBlockDiag const & a )`

6.13.2.4 `MyMat& Tspeed::MyMat::operator= ( MyMat && )` [default]

6.13.2.5 `MyMat& Tspeed::MyMat::operator= ( MyMat const & )` [default]

6.13.2.6 void Tspeed::MyMat::sumtranspose ( MyMat const & ot )

6.13.2.7 void Tspeed::MyMat::symmetrize ( )

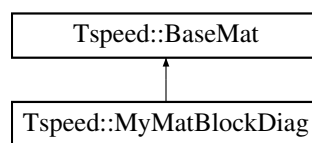
The documentation for this class was generated from the following files:

- [lib/include/MyMat.hpp](#)
- [lib/src/MyMat.cpp](#)

## 6.14 Tspeed::MyMatBlockDiag Class Reference

```
#include <MyMat.hpp>
```

Inheritance diagram for Tspeed::MyMatBlockDiag:



### Public Member Functions

- [MyMatBlockDiag](#) ( )
- [MyMatBlockDiag](#) (Mesh\_ptr, unsigned int nIn)
- [MyMatBlockDiag](#) (MyMatBlockDiag &&)=default
- [MyMatBlockDiag](#) (MyMatBlockDiag const &)=default
- [MyMatBlockDiag](#) & operator= (MyMatBlockDiag &&)=default
- [MyMatBlockDiag](#) & operator= (MyMatBlockDiag const &)=default
- virtual [~MyMatBlockDiag](#) ( ) noexcept(true)=default

### Additional Inherited Members

#### 6.14.1 Constructor & Destructor Documentation

6.14.1.1 Tspeed::MyMatBlockDiag::MyMatBlockDiag ( ) [inline]

6.14.1.2 Tspeed::MyMatBlockDiag::MyMatBlockDiag ( Mesh\_ptr Th, unsigned int nIn )

6.14.1.3 Tspeed::MyMatBlockDiag::MyMatBlockDiag ( MyMatBlockDiag && ) [default]

6.14.1.4 Tspeed::MyMatBlockDiag::MyMatBlockDiag ( MyMatBlockDiag const & ) [default]

6.14.1.5 virtual Tspeed::MyMatBlockDiag::~~MyMatBlockDiag ( ) [virtual],[default],[noexcept]

#### 6.14.2 Member Function Documentation

6.14.2.1 MyMatBlockDiag& Tspeed::MyMatBlockDiag::operator= ( MyMatBlockDiag && ) [default]

6.14.2.2 MyMatBlockDiag& Tspeed::MyMatBlockDiag::operator= ( MyMatBlockDiag const & ) [default]

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



- [lib/include/MyMat.hpp](#)
- [lib/src/MyMat.cpp](#)

## 6.15 Tspeed::MyMatMultiDim< T > Class Template Reference

```
#include <MyMat.hpp>
```

### Public Member Functions

- [MyMatMultiDim](#) ()=default
- virtual [~MyMatMultiDim](#) ()=default
- [MyMatMultiDim](#) ([Mesh\\_ptr](#), unsigned int *nln*)
- T & [component](#) (int *i*, int *j*)
- T const & [component](#) (int *i*, int *j*) const
- void [symmetrize](#) ()
- void [vecMult](#) (Eigen::VectorXd const &, Eigen::VectorXd &) const
- [MyMatMultiDim](#) ([MyMatMultiDim](#) &*a*)
- [MyMatMultiDim](#) & [operator=](#) ([MyMatMultiDim](#) &&)=default
- Eigen::VectorXd [operator\\*](#) (Eigen::VectorXd const &*v*) const

### Friends

- [MyMatMultiDim](#)< [MyMat](#) > [operator+](#) ([MyMatMultiDim](#)< [MyMat](#) > const &*a*, [MyMatMultiDim](#)< [MyMat](#) > const &*b*)
- [MyMatMultiDim](#)< [MyMat](#) > [operator+](#) ([MyMatMultiDim](#)< [MyMat](#) > const &*a*, [MyMatMultiDim](#)< [MyMatBlock-Diag](#) > const &*b*)
- [MyMatMultiDim](#)< T > [operator\\*](#) (double const &*x*, [MyMatMultiDim](#)< T > const &*A*)

### 6.15.1 Constructor & Destructor Documentation

6.15.1.1 `template<typename T> Tspeed::MyMatMultiDim< T >::MyMatMultiDim ( ) [default]`

6.15.1.2 `template<typename T> virtual Tspeed::MyMatMultiDim< T >::~~MyMatMultiDim ( ) [virtual], [default]`

6.15.1.3 `template<typename T> Tspeed::MyMatMultiDim< T >::MyMatMultiDim ( Mesh\_ptr m, unsigned int nln )`

6.15.1.4 `template<typename T> Tspeed::MyMatMultiDim< T >::MyMatMultiDim ( MyMatMultiDim< T > &a ) [inline]`

### 6.15.2 Member Function Documentation

6.15.2.1 `template<typename T> T& Tspeed::MyMatMultiDim< T >::component ( int i, int j ) [inline]`

6.15.2.2 `template<typename T> T const& Tspeed::MyMatMultiDim< T >::component ( int i, int j ) const [inline]`

6.15.2.3 `template<typename T> Eigen::VectorXd Tspeed::MyMatMultiDim< T >::operator* ( Eigen::VectorXd const &v ) const`

6.15.2.4 `template<typename T> MyMatMultiDim& Tspeed::MyMatMultiDim< T >::operator= ( MyMatMultiDim< T > && ) [default]`

6.15.2.5 `template<typename T> void Tspeed::MyMatMultiDim< T >::symmetrize ( )`

6.15.2.6 `template<typename T> void Tspeed::MyMatMultiDim< T >::vecMult ( Eigen::VectorXd const & x, Eigen::VectorXd & out ) const`

### 6.15.3 Friends And Related Function Documentation

6.15.3.1 `template<typename T> MyMatMultiDim<T> operator* ( double const & x, MyMatMultiDim< T > const & A ) [friend]`

6.15.3.2 `template<typename T> MyMatMultiDim<MyMat> operator+ ( MyMatMultiDim< MyMat > const & a, MyMatMultiDim< MyMat > const & b ) [friend]`

6.15.3.3 `template<typename T> MyMatMultiDim<MyMat> operator+ ( MyMatMultiDim< MyMat > const & a, MyMatMultiDim< MyMatBlockDiag > const & b ) [friend]`

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

- [lib/include/MyMat.hpp](#)

## 6.16 Tspeed::MyMatMultiDimBlockDiag< T > Class Template Reference

```
#include <MyMat.hpp>
```

### Public Member Functions

- [MyMatMultiDimBlockDiag](#) ()=default
- virtual [~MyMatMultiDimBlockDiag](#) ()=default
- [MyMatMultiDimBlockDiag](#) ([Mesh\\_ptr](#), unsigned int nln)
- T & [component](#) (int i)
- T const & [component](#) (int i) const
- void [vecMult](#) (Eigen::VectorXd const &, Eigen::VectorXd &) const
- [MyMatMultiDimBlockDiag](#) ([MyMatMultiDimBlockDiag](#) &&)=default
- [MyMatMultiDimBlockDiag](#) & [operator=](#) ([MyMatMultiDimBlockDiag](#) &&)=default
- unsigned int [nr](#) () const
- Eigen::VectorXd [operator\\*](#) (Eigen::VectorXd const &v) const

### Friends

- [MyMatMultiDimBlockDiag](#) const & [operator\\*](#) (double const &x, [MyMatMultiDimBlockDiag](#) const &A)

### 6.16.1 Constructor & Destructor Documentation

6.16.1.1 `template<typename T> Tspeed::MyMatMultiDimBlockDiag< T >::MyMatMultiDimBlockDiag ( ) [default]`

6.16.1.2 `template<typename T> virtual Tspeed::MyMatMultiDimBlockDiag< T >::~~MyMatMultiDimBlockDiag ( ) [virtual],[default]`

6.16.1.3 `template<typename T> Tspeed::MyMatMultiDimBlockDiag< T >::MyMatMultiDimBlockDiag ( Mesh_ptr m, unsigned int nln )`

6.16.1.4 `template<typename T> Tspeed::MyMatMultiDimBlockDiag< T >::MyMatMultiDimBlockDiag ( MyMatMultiDimBlockDiag< T > && ) [default]`

## 6.16.2 Member Function Documentation

6.16.2.1 `template<typename T> T& Tspeed::MyMatMultiDimBlockDiag< T >::component ( int i ) [inline]`

6.16.2.2 `template<typename T> T const& Tspeed::MyMatMultiDimBlockDiag< T >::component ( int i ) const [inline]`

6.16.2.3 `template<typename T> unsigned int Tspeed::MyMatMultiDimBlockDiag< T >::nr ( ) const [inline]`

6.16.2.4 `template<typename T > Eigen::VectorXd Tspeed::MyMatMultiDimBlockDiag< T >::operator* ( Eigen::VectorXd const & v ) const`

6.16.2.5 `template<typename T> MyMatMultiDimBlockDiag& Tspeed::MyMatMultiDimBlockDiag< T >::operator= ( MyMatMultiDimBlockDiag< T > && ) [default]`

6.16.2.6 `template<typename T > void Tspeed::MyMatMultiDimBlockDiag< T >::vecMult ( Eigen::VectorXd const & x, Eigen::VectorXd & out ) const`

## 6.16.3 Friends And Related Function Documentation

6.16.3.1 `template<typename T> MyMatMultiDimBlockDiag const& operator* ( double const & x, MyMatMultiDimBlockDiag< T > const & A ) [friend]`

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

- [lib/include/MyMat.hpp](#)

## 6.17 Tspeed::Parameters Class Reference

```
#include <FESpace.hpp>
```

### Public Member Functions

- virtual [~Parameters](#) ()
- [Parameters](#) ([Mesh\\_ptr](#) m)
- void [setp](#) (std::string const &, int const , double const )
- double const & [lambda](#) (int i) const
- double const & [mu](#) (int i) const
- double const & [rho](#) (int i) const
- double [avg\\_p](#) (std::string const &, int i, int j) const

### 6.17.1 Constructor & Destructor Documentation

6.17.1.1 `virtual Tspeed::Parameters::~~Parameters ( ) [inline],[virtual]`

6.17.1.2 `Tspeed::Parameters::Parameters ( Mesh_ptr m ) [inline]`

### 6.17.2 Member Function Documentation

6.17.2.1 `double Tspeed::Parameters::avg_p ( std::string const & p, int i, int j ) const`

6.17.2.2 `double const& Tspeed::Parameters::lambda ( int i ) const` `[inline]`

6.17.2.3 `double const& Tspeed::Parameters::mu ( int i ) const` `[inline]`

6.17.2.4 `double const& Tspeed::Parameters::rho ( int i ) const` `[inline]`

6.17.2.5 `void Tspeed::Parameters::setp ( std::string const & p, int const lab, double const lambda )`

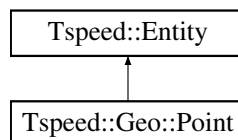
The documentation for this class was generated from the following files:

- [lib/include/FESpace.hpp](#)
- [lib/src/Parameters.cpp](#)

## 6.18 Tspeed::Geo::Point Class Reference

```
#include <Geometry.hpp>
```

Inheritance diagram for Tspeed::Geo::Point:



### Public Member Functions

- [Point](#) (const double &x=0, const double &y=0)
- [Point](#) (const [Point](#) &p)
- [Point](#) (const Eigen::Vector2d &v)
- virtual [~Point](#) ()
- double [x](#) () const
- double [y](#) () const
- double & [x](#) ()
- double & [y](#) ()
- [Point](#) & [operator=](#) (const [Point](#) &)
- [Point](#) [operator\\*](#) (const double &) const
- double [norm](#) () const
- Eigen::Vector2d [toEig](#) () const

### Friends

- [Point](#) [operator+](#) (const [Point](#) &, const [Point](#) &)
- [Point](#) [operator+](#) (const Eigen::Vector2d &, const [Point](#) &)
- [Point](#) [operator+](#) (const [Point](#) &, const Eigen::Vector2d &)
- [Point](#) [operator-](#) (const [Point](#) &, const [Point](#) &)
- [Point](#) [operator-](#) (const Eigen::Vector2d &, const [Point](#) &)
- [Point](#) [operator-](#) (const [Point](#) &, const Eigen::Vector2d &)
- [Point](#) [operator\\*](#) (const double &, const [Point](#) &)
- double [dot](#) (const [Point](#) &a, const [Point](#) &b)

## Additional Inherited Members

### 6.18.1 Constructor & Destructor Documentation

6.18.1.1 `Tspeed::Geo::Point::Point ( const double & x = 0, const double & y = 0 )` `[inline]`

6.18.1.2 `Tspeed::Geo::Point::Point ( const Point & p )` `[inline]`

6.18.1.3 `Tspeed::Geo::Point::Point ( const Eigen::Vector2d & v )` `[inline]`

6.18.1.4 `virtual Tspeed::Geo::Point::~~Point ( )` `[inline]`, `[virtual]`

### 6.18.2 Member Function Documentation

6.18.2.1 `double Tspeed::Geo::Point::norm ( ) const` `[inline]`

6.18.2.2 `Point Tspeed::Geo::Point::operator* ( const double & d ) const`

6.18.2.3 `Point & Tspeed::Geo::Point::operator= ( const Point & p )`

6.18.2.4 `Eigen::Vector2d Tspeed::Geo::Point::toEig ( ) const` `[inline]`

6.18.2.5 `double Tspeed::Geo::Point::x ( ) const` `[inline]`

6.18.2.6 `double& Tspeed::Geo::Point::x ( )` `[inline]`

6.18.2.7 `double Tspeed::Geo::Point::y ( ) const` `[inline]`

6.18.2.8 `double& Tspeed::Geo::Point::y ( )` `[inline]`

### 6.18.3 Friends And Related Function Documentation

6.18.3.1 `double dot ( const Point & a, const Point & b )` `[friend]`

6.18.3.2 `Point operator* ( const double & d, const Point & p )` `[friend]`

6.18.3.3 `Point operator+ ( const Point & a, const Point & b )` `[friend]`

6.18.3.4 `Point operator+ ( const Eigen::Vector2d & a, const Point & b )` `[friend]`

6.18.3.5 `Point operator+ ( const Point & a, const Eigen::Vector2d & b )` `[friend]`

6.18.3.6 `Point operator- ( const Point & a, const Point & b )` `[friend]`

6.18.3.7 `Point operator- ( const Eigen::Vector2d & a, const Point & b )` `[friend]`

6.18.3.8 `Point operator- ( const Point & a, const Eigen::Vector2d & b )` `[friend]`

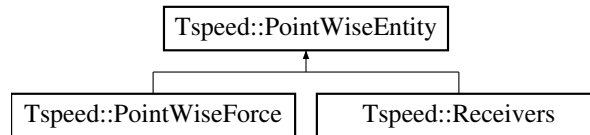
The documentation for this class was generated from the following files:

- [lib/include/Geometry.hpp](#)
- [lib/src/Geometry.cpp](#)

## 6.19 Tspeed::PointWiseEntity Class Reference

```
#include <Receivers.hpp>
```

Inheritance diagram for Tspeed::PointWiseEntity:



### Public Member Functions

- virtual [~PointWiseEntity](#) ()
- Eigen::ArrayXd const & [shape](#) (int *i*) const
- [Geo::Point](#) const & [point](#) (int *i*) const
- unsigned int const & [elem](#) (int *i*) const
- unsigned int [size](#) () const

### Protected Member Functions

- template<int N, typename Q, typename S >  
void [M\\_add](#) ([FESpace\\_ptr](#)< N, Q, S >, [Geo::Point](#) const &)

### Protected Attributes

- std::vector< unsigned int > [M\\_ie](#)
- std::vector< [Geo::Point](#) > [M\\_relp](#)
- std::vector< Eigen::ArrayXd > [M\\_shape](#)
- unsigned int [M\\_nel](#)

### 6.19.1 Constructor & Destructor Documentation

6.19.1.1 virtual Tspeed::PointWiseEntity::~~PointWiseEntity ( ) [\[inline\]](#), [\[virtual\]](#)

### 6.19.2 Member Function Documentation

6.19.2.1 unsigned int const& Tspeed::PointWiseEntity::elem ( int *i* ) const [\[inline\]](#)

6.19.2.2 template<int N, typename Q, typename S > void Tspeed::PointWiseEntity::M.add ( [FESpace\\_ptr](#)< N, Q, S > *Xh*, [Geo::Point](#) const & *p* ) [\[protected\]](#)

6.19.2.3 [Geo::Point](#) const& Tspeed::PointWiseEntity::point ( int *i* ) const [\[inline\]](#)

6.19.2.4 Eigen::ArrayXd const& Tspeed::PointWiseEntity::shape ( int *i* ) const [\[inline\]](#)

6.19.2.5 unsigned int Tspeed::PointWiseEntity::size ( ) const [\[inline\]](#)

### 6.19.3 Member Data Documentation

6.19.3.1 std::vector<unsigned int> Tspeed::PointWiseEntity::M.ie [\[protected\]](#)

6.19.3.2 `unsigned int Tspeed::PointWiseEntity::M_nel` `[protected]`

6.19.3.3 `std::vector<Geo::Point> Tspeed::PointWiseEntity::M_relp` `[protected]`

6.19.3.4 `std::vector<Eigen::ArrayXd> Tspeed::PointWiseEntity::M_shape` `[protected]`

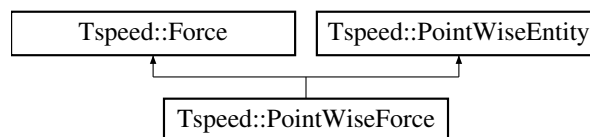
The documentation for this class was generated from the following files:

- [lib/include/Receivers.hpp](#)
- [lib/include/Receivers\\_imp.hpp](#)

## 6.20 Tspeed::PointWiseForce Class Reference

```
#include <Force.hpp>
```

Inheritance diagram for Tspeed::PointWiseForce:



### Public Member Functions

- `template<int N, typename Q, typename S> PointWiseForce (std::function< std::array< double, 2>(const double &)> const &, Geo::Point, FESpace_ptr< N, Q, S> )`
- `virtual ~PointWiseForce ()`
- `Vec eval (const double &) const`

### Additional Inherited Members

#### 6.20.1 Constructor & Destructor Documentation

6.20.1.1 `template<int N, typename Q, typename S> Tspeed::PointWiseForce::PointWiseForce ( std::function< std::array< double, 2>(const double &)> const & f, Geo::Point p, FESpace_ptr< N, Q, S> Xh )`

6.20.1.2 `virtual Tspeed::PointWiseForce::~~PointWiseForce ( )` `[inline], [virtual]`

#### 6.20.2 Member Function Documentation

6.20.2.1 `Eigen::VectorXd Tspeed::PointWiseForce::eval ( const double & t ) const` `[virtual]`

Implements [Tspeed::Force](#).

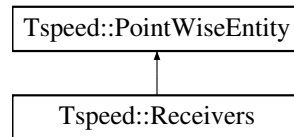
The documentation for this class was generated from the following files:

- [lib/include/Force.hpp](#)
- [lib/include/Force\\_imp.hpp](#)
- [lib/src/Force.cpp](#)

## 6.21 Tspeed::Receivers Class Reference

```
#include <Receivers.hpp>
```

Inheritance diagram for Tspeed::Receivers:



### Public Member Functions

- `template<int N, typename Q, typename S >`  
[Receivers](#) ([FESpace\\_ptr](#)< N, Q, S >, `std::string const &`)
- `template<int N, typename Q, typename S >`  
[Receivers](#) ([FESpace\\_ptr](#)< N, Q, S >, [Geo::Point](#) const &)
- `void` [add](#) (`double const &x`, `double const &y`, `unsigned int const &`, `unsigned int const &`)
- `void` [write](#) (`std::string const &`) `const`

### Additional Inherited Members

#### 6.21.1 Constructor & Destructor Documentation

6.21.1.1 `template<int N, typename Q, typename S > Tspeed::Receivers::Receivers ( FESpace\_ptr< N, Q, S > Xh, std::string const & fname )`

6.21.1.2 `template<int N, typename Q, typename S > Tspeed::Receivers::Receivers ( FESpace\_ptr< N, Q, S > Xh, Geo::Point const & p )`

#### 6.21.2 Member Function Documentation

6.21.2.1 `void Tspeed::Receivers::add ( double const & x, double const & y, unsigned int const & ir, unsigned int const & step )`

6.21.2.2 `void Tspeed::Receivers::write ( std::string const & fn ) const`

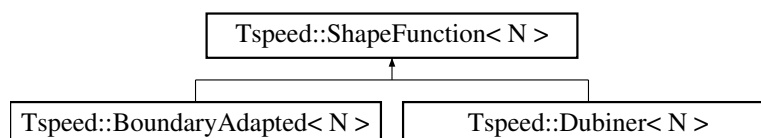
The documentation for this class was generated from the following files:

- `lib/include/Receivers.hpp`
- `lib/include/Receivers_imp.hpp`
- `lib/src/Receivers.cpp`

## 6.22 Tspeed::ShapeFunction< N > Class Template Reference

```
#include <ShapeFunctions.hpp>
```

Inheritance diagram for Tspeed::ShapeFunction< N >:





## Public Types

- enum { `gdl` = (N+1)\*(N+2)/2 }
- enum { `is_orthonormal` = false }

## Public Member Functions

- virtual `~ShapeFunction` ()
- `ShapeFunction` ()
- Eigen::ArrayXd `phi` (unsigned int s, Arr const &v, Arr const &w) const
- double `phi` (unsigned int s, double x, double y) const
- ArrG `grad` (unsigned int s, Arr const &v, Arr const &w)

## Protected Attributes

- std::vector< std::function  
< Arr(Arr const &, Arr const &)> > `M_phi`
- std::vector< std::function  
< ArrG(Arr const &, Arr const &)> > `M_grad`

### 6.22.1 Member Enumeration Documentation

#### 6.22.1.1 template<int N> anonymous enum

Enumerator

***gdl***

#### 6.22.1.2 template<int N> anonymous enum

Enumerator

***is\_orthonormal***

### 6.22.2 Constructor & Destructor Documentation

6.22.2.1 template<int N> virtual Tspeed::ShapeFunction< N >::~ShapeFunction ( ) [inline],  
[virtual]

6.22.2.2 template<int N> Tspeed::ShapeFunction< N >::~ShapeFunction ( ) [inline]

### 6.22.3 Member Function Documentation

6.22.3.1 template<int N> ArrG Tspeed::ShapeFunction< N >::grad ( unsigned int s, Arr const & v, Arr const & w )  
[inline]

6.22.3.2 template<int N> Eigen::ArrayXd Tspeed::ShapeFunction< N >::phi ( unsigned int s, Arr const & v, Arr const & w ) const [inline]

6.22.3.3 template<int N> double Tspeed::ShapeFunction< N >::phi ( unsigned int s, double x, double y ) const  
[inline]

### 6.22.4 Member Data Documentation

6.22.4.1 `template<int N> std::vector<std::function<ArrG(Arr const &, Arr const &)>> Tspeed::ShapeFunction< N>::M_grad` [protected]

6.22.4.2 `template<int N> std::vector<std::function<Arr(Arr const &, Arr const &)>> Tspeed::ShapeFunction< N>::M_phi` [protected]

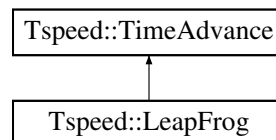
The documentation for this class was generated from the following file:

- [lib/include/ShapeFunctions.hpp](#)

## 6.23 Tspeed::TimeAdvance Class Reference

```
#include <TimeAdvance.hpp>
```

Inheritance diagram for Tspeed::TimeAdvance:



### Public Member Functions

- void [first\\_step](#) ()
- void [step](#) (double)
- virtual [~TimeAdvance](#) ()
- template<int N, typename Q, typename S >  
[TimeAdvance](#) (FESpace\_ptr< N, Q, S >, [Parameters](#) const &, [Receivers](#) const &)
- void [set\\_dt](#) (double dt)
- void [set\\_tmax](#) (double tmax)
- void [set\\_penalty](#) (double p)
- void [add\\_force](#) (std::shared\_ptr< [Force](#) > f)
- template<int N, typename Q, typename S >  
void [set\\_initial\\_v](#) (FESpace\_ptr< N, Q, S > Xh, [std::function](#)< std::array< double, 2 >(double, double)> fun)
- template<int N, typename Q, typename S >  
void [set\\_initial\\_u](#) (FESpace\_ptr< N, Q, S > Xh, [std::function](#)< std::array< double, 2 >(double, double)> fun)
- bool [is\\_running](#) ()
- Vec const & [get\\_uh](#) () const
- void [eval\\_receivers](#) ()
- void [write\\_receivers](#) (std::string const &fn) const
- Vec const & [u](#) () const

### Protected Member Functions

- void [update\\_variables](#) (double t)

## Protected Attributes

- double [M\\_penalty](#)
- double [M\\_dt](#)
- double [M\\_tmax](#)
- Vec [f](#)
- Vec [fold](#)
- Vec [foldold](#)
- Vec [uh](#)
- Vec [uhold](#)
- Vec [uholdold](#)
- Vec [initial\\_v](#)
- [Receivers](#) [M\\_recv](#)
- [Matrices](#) [M\\_mat](#)
- [MyMatMultiDim](#)< [MyMat](#) > [B](#)
- [std::shared\\_ptr](#)< [Force](#) > [M\\_f](#)
- bool [M\\_completed](#)
- double [M\\_last\\_step](#)
- unsigned int [M\\_recv\\_written](#)
- unsigned int [M\\_nln](#)
- unsigned int [M\\_ne](#)

### 6.23.1 Constructor & Destructor Documentation

6.23.1.1 `virtual Tspeed::TimeAdvance::~TimeAdvance ( ) [inline], [virtual]`

6.23.1.2 `template<int N, typename Q, typename S > Tspeed::TimeAdvance::TimeAdvance ( FESpace_ptr< N, Q, S > Xh, Parameters const & p, Receivers const & r )`

### 6.23.2 Member Function Documentation

6.23.2.1 `void Tspeed::TimeAdvance::add_force ( std::shared_ptr< Force > f ) [inline]`

6.23.2.2 `void Tspeed::TimeAdvance::eval_receivers ( )`

6.23.2.3 `void Tspeed::TimeAdvance::first_step ( )`

6.23.2.4 `Vec const& Tspeed::TimeAdvance::get_uh ( ) const [inline]`

6.23.2.5 `bool Tspeed::TimeAdvance::is_running ( ) [inline]`

6.23.2.6 `void Tspeed::TimeAdvance::set_dt ( double dt ) [inline]`

6.23.2.7 `template<int N, typename Q, typename S > void Tspeed::TimeAdvance::set_initial_u ( FESpace_ptr< N, Q, S > Xh, std::function< std::array< double, 2 >(double, double)> fun )`

6.23.2.8 `template<int N, typename Q, typename S > void Tspeed::TimeAdvance::set_initial_v ( FESpace_ptr< N, Q, S > Xh, std::function< std::array< double, 2 >(double, double)> fun )`

6.23.2.9 `void Tspeed::TimeAdvance::set_penalty ( double p ) [inline]`

6.23.2.10 `void Tspeed::TimeAdvance::set_tmax ( double tmax ) [inline]`

6.23.2.11 `void Tspeed::TimeAdvance::step ( double )`

6.23.2.12 `Vec const& Tspeed::TimeAdvance::u ( ) const` [inline]

6.23.2.13 `void Tspeed::TimeAdvance::update_variables ( double t )` [inline], [protected]

6.23.2.14 `void Tspeed::TimeAdvance::write_receivers ( std::string const & fn ) const` [inline]

### 6.23.3 Member Data Documentation

6.23.3.1 `MyMatMultiDim<MyMat> Tspeed::TimeAdvance::B` [protected]

6.23.3.2 `Vec Tspeed::TimeAdvance::f` [protected]

6.23.3.3 `Vec Tspeed::TimeAdvance::fold` [protected]

6.23.3.4 `Vec Tspeed::TimeAdvance::foldold` [protected]

6.23.3.5 `Vec Tspeed::TimeAdvance::initial_v` [protected]

6.23.3.6 `bool Tspeed::TimeAdvance::M_completed` [protected]

6.23.3.7 `double Tspeed::TimeAdvance::M_dt` [protected]

6.23.3.8 `std::shared_ptr<Force> Tspeed::TimeAdvance::M_f` [protected]

6.23.3.9 `double Tspeed::TimeAdvance::M_last_step` [protected]

6.23.3.10 `Matrices Tspeed::TimeAdvance::M_mat` [protected]

6.23.3.11 `unsigned int Tspeed::TimeAdvance::M_ne` [protected]

6.23.3.12 `unsigned int Tspeed::TimeAdvance::M_nln` [protected]

6.23.3.13 `double Tspeed::TimeAdvance::M_penalty` [protected]

6.23.3.14 `Receivers Tspeed::TimeAdvance::M_recv` [protected]

6.23.3.15 `unsigned int Tspeed::TimeAdvance::M_recv_written` [protected]

6.23.3.16 `double Tspeed::TimeAdvance::M_tmax` [protected]

6.23.3.17 `Vec Tspeed::TimeAdvance::uh` [protected]

6.23.3.18 `Vec Tspeed::TimeAdvance::uhold` [protected]

6.23.3.19 `Vec Tspeed::TimeAdvance::uholdold` [protected]

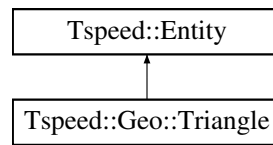
The documentation for this class was generated from the following files:

- [lib/include/TimeAdvance.hpp](#)
- [lib/include/TimeAdvance\\_imp.hpp](#)
- [lib/src/TimeAdvance.cpp](#)

## 6.24 Tspeed::Geo::Triangle Class Reference

```
#include <Geometry.hpp>
```

Inheritance diagram for Tspeed::Geo::Triangle:



## Public Member Functions

- [Triangle](#) ()
- [Triangle](#) (const [Point](#) &, const [Point](#) &, const [Point](#) &)
- [Triangle](#) (const [Triangle](#) &)=default
- [Triangle](#) & [operator=](#) (const [Triangle](#) &)
- virtual [~Triangle](#) ()
- std::array< [Point](#), 3 > [all\\_pts](#) () const
- std::array< [Edge](#), 3 > [all\\_edges](#) () const
- [Point](#) const & [pt](#) (int i) const
- [Edge](#) const & [edg](#) (int i) const
- Eigen::Matrix2d [Jac](#) () const
- Eigen::Matrix2d [invJac](#) () const
- double [detJ](#) () const
- [Point](#) map ([Point](#) const &p) const
- [Point](#) invmap ([Point](#) const &p) const
- int const & [neigh](#) (int i) const
- int const & [neighedges](#) (int i) const
- void [setNeigh](#) (int i, int j)
- void [setNeighedges](#) (int i, int j)
- void [printNeigh](#) () const
- bool [intriangle](#) (const [Point](#) &) const

## Static Public Attributes

- static const int [numVertices](#) =3

## Additional Inherited Members

### 6.24.1 Constructor & Destructor Documentation

6.24.1.1 `Tspeed::Geo::Triangle::Triangle ( )`

6.24.1.2 `Tspeed::Geo::Triangle::Triangle ( const Point & a, const Point & b, const Point & c )`

6.24.1.3 `Tspeed::Geo::Triangle::Triangle ( const Triangle & )` [default]

6.24.1.4 `virtual Tspeed::Geo::Triangle::~~Triangle ( )` [inline],[virtual]

### 6.24.2 Member Function Documentation

6.24.2.1 `std::array<Edge,3> Tspeed::Geo::Triangle::all_edges ( ) const` [inline]

6.24.2.2 `std::array<Point,3> Tspeed::Geo::Triangle::all_pts ( ) const` [inline]

- 6.24.2.3 `double Tspeed::Geo::Triangle::detJ ( ) const`
- 6.24.2.4 `Edge const& Tspeed::Geo::Triangle::edg ( int i ) const` `[inline]`
- 6.24.2.5 `bool Tspeed::Geo::Triangle::intriangle ( const Point & p ) const`
- 6.24.2.6 `Eigen::Matrix2d Tspeed::Geo::Triangle::invJac ( ) const`
- 6.24.2.7 `Point Tspeed::Geo::Triangle::invmap ( Point const & p ) const`
- 6.24.2.8 `Eigen::Matrix2d Tspeed::Geo::Triangle::Jac ( ) const`
- 6.24.2.9 `Point Tspeed::Geo::Triangle::map ( Point const & p ) const`
- 6.24.2.10 `int const& Tspeed::Geo::Triangle::neigh ( int i ) const` `[inline]`
- 6.24.2.11 `int const& Tspeed::Geo::Triangle::neighedges ( int i ) const` `[inline]`
- 6.24.2.12 `Triangle & Tspeed::Geo::Triangle::operator= ( const Triangle & t )`
- 6.24.2.13 `void Tspeed::Geo::Triangle::printNeigh ( ) const` `[inline]`
- 6.24.2.14 `Point const& Tspeed::Geo::Triangle::pt ( int i ) const` `[inline]`
- 6.24.2.15 `void Tspeed::Geo::Triangle::setNeigh ( int i, int j )` `[inline]`
- 6.24.2.16 `void Tspeed::Geo::Triangle::setNeighedges ( int i, int j )` `[inline]`

### 6.24.3 Member Data Documentation

- 6.24.3.1 `const int Tspeed::Geo::Triangle::numVertices =3` `[static]`

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

- [lib/include/Geometry.hpp](#)
- [lib/src/Geometry.cpp](#)

## Chapter 7

# File Documentation

### 7.1 Examples/src/Lamb.cpp File Reference

```
#include "TSPEED.hpp"  
#include <iostream>
```

#### Functions

- int [main](#) ()

#### 7.1.1 Function Documentation

7.1.1.1 int main ( )

### 7.2 Examples/src/wedge.cpp File Reference

```
#include "TSPEED.hpp"  
#include <iostream>  
#include <memory>
```

#### Functions

- void [wedge\\_init\\_param](#) (double *l*, double *m*, double *rho*, double *cf*, double *csurf*, double &*k*, double &*q*, double &*s*, double &*beta*)
- int [main](#) ()

#### 7.2.1 Function Documentation

7.2.1.1 int main ( )

7.2.1.2 void wedge\_init\_param ( double *l*, double *m*, double *rho*, double *cf*, double *csurf*, double & *k*, double & *q*, double & *s*, double & *beta* )

### 7.3 lib/include/Dunavant.hpp File Reference

## Functions

- int [dunavant\\_degree](#) (int rule)
- int [dunavant\\_order\\_num](#) (int rule)
- void [dunavant\\_rule](#) (int rule, int order\_num, double xy[], double w[])
- int [dunavant\\_rule\\_num](#) (void)
- int \* [dunavant\\_suborder](#) (int rule, int suborder\_num)
- int [dunavant\\_suborder\\_num](#) (int rule)
- void [dunavant\\_subrule](#) (int rule, int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_01](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_02](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_03](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_04](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_05](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_06](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_07](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_08](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_09](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_10](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_11](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_12](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_13](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_14](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_15](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_16](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_17](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_18](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_19](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_20](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [file\\_name\\_inc](#) (char \*file\_name)
- int [i4\\_max](#) (int i1, int i2)
- int [i4\\_min](#) (int i1, int i2)
- int [i4\\_modp](#) (int i, int j)
- int [i4\\_wrap](#) (int ival, int ilo, int ihi)
- double [r8\\_huge](#) (void)
- int [r8\\_nint](#) (double x)
- void [reference\\_to\\_physical\\_t3](#) (double t[], int n, double ref[], double phy[])
- int [s\\_len\\_trim](#) (char \*s)
- void [timestamp](#) (void)
- char \* [timestring](#) (void)
- double [triangle\\_area](#) (double t[2 \* 3])
- void [triangle\\_points\\_plot](#) (char \*file\_name, double node\_xy[], int node\_show, int point\_num, double point\_xy[], int point\_show)

### 7.3.1 Function Documentation

7.3.1.1 int [dunavant\\_degree](#) ( int *rule* )

7.3.1.2 int [dunavant\\_order\\_num](#) ( int *rule* )

7.3.1.3 void [dunavant\\_rule](#) ( int *rule*, int *order\_num*, double *xy*[], double *w*[] )

7.3.1.4 int [dunavant\\_rule\\_num](#) ( void )



- 7.3.1.5 `int* dunavant_suborder ( int rule, int suborder_num )`
- 7.3.1.6 `int dunavant_suborder_num ( int rule )`
- 7.3.1.7 `void dunavant_subrule ( int rule, int suborder_num, double suborder_xyz[], double suborder_w[] )`
- 7.3.1.8 `void dunavant_subrule_01 ( int suborder_num, double suborder_xyz[], double suborder_w[] )`
- 7.3.1.9 `void dunavant_subrule_02 ( int suborder_num, double suborder_xyz[], double suborder_w[] )`
- 7.3.1.10 `void dunavant_subrule_03 ( int suborder_num, double suborder_xyz[], double suborder_w[] )`
- 7.3.1.11 `void dunavant_subrule_04 ( int suborder_num, double suborder_xyz[], double suborder_w[] )`
- 7.3.1.12 `void dunavant_subrule_05 ( int suborder_num, double suborder_xyz[], double suborder_w[] )`
- 7.3.1.13 `void dunavant_subrule_06 ( int suborder_num, double suborder_xyz[], double suborder_w[] )`
- 7.3.1.14 `void dunavant_subrule_07 ( int suborder_num, double suborder_xyz[], double suborder_w[] )`
- 7.3.1.15 `void dunavant_subrule_08 ( int suborder_num, double suborder_xyz[], double suborder_w[] )`
- 7.3.1.16 `void dunavant_subrule_09 ( int suborder_num, double suborder_xyz[], double suborder_w[] )`
- 7.3.1.17 `void dunavant_subrule_10 ( int suborder_num, double suborder_xyz[], double suborder_w[] )`
- 7.3.1.18 `void dunavant_subrule_11 ( int suborder_num, double suborder_xyz[], double suborder_w[] )`
- 7.3.1.19 `void dunavant_subrule_12 ( int suborder_num, double suborder_xyz[], double suborder_w[] )`
- 7.3.1.20 `void dunavant_subrule_13 ( int suborder_num, double suborder_xyz[], double suborder_w[] )`
- 7.3.1.21 `void dunavant_subrule_14 ( int suborder_num, double suborder_xyz[], double suborder_w[] )`
- 7.3.1.22 `void dunavant_subrule_15 ( int suborder_num, double suborder_xyz[], double suborder_w[] )`
- 7.3.1.23 `void dunavant_subrule_16 ( int suborder_num, double suborder_xyz[], double suborder_w[] )`
- 7.3.1.24 `void dunavant_subrule_17 ( int suborder_num, double suborder_xyz[], double suborder_w[] )`
- 7.3.1.25 `void dunavant_subrule_18 ( int suborder_num, double suborder_xyz[], double suborder_w[] )`
- 7.3.1.26 `void dunavant_subrule_19 ( int suborder_num, double suborder_xyz[], double suborder_w[] )`
- 7.3.1.27 `void dunavant_subrule_20 ( int suborder_num, double suborder_xyz[], double suborder_w[] )`
- 7.3.1.28 `void file_name_inc ( char * file_name )`
- 7.3.1.29 `int i4_max ( int i1, int i2 )`
- 7.3.1.30 `int i4_min ( int i1, int i2 )`
- 7.3.1.31 `int i4_modp ( int i, int j )`
- 7.3.1.32 `int i4_wrap ( int ival, int ilo, int ihi )`

7.3.1.33 `double r8_huge ( void )`

7.3.1.34 `int r8_nint ( double x )`

7.3.1.35 `void reference_to_physical_t3 ( double t[], int n, double ref[], double phy[] )`

7.3.1.36 `int s_len_trim ( char * s )`

7.3.1.37 `void timestamp ( void )`

7.3.1.38 `char* timestring ( void )`

7.3.1.39 `double triangle_area ( double t[2*3] )`

7.3.1.40 `void triangle_points_plot ( char * file_name, double node_xy[], int node_show, int point_num, double point_xy[], int point_show )`

## 7.4 lib/include/FESpace.hpp File Reference

```
#include "QuadratureRule.hpp"
#include "ShapeFunctions.hpp"
#include "Mesh.hpp"
#include <Eigen/Dense>
#include <Eigen/StdVector>
#include <functional>
#include "FESpace_imp.hpp"
```

### Classes

- class [Tspeed::FESpace< N, Q, S >](#)
- class [Tspeed::Parameters](#)

### Namespaces

- namespace [Tspeed](#)

### Typedefs

- `template<int N, typename Q = Gauss<N+1>, typename S = Dubiner<N>>`  
using [Tspeed::FESpace\\_ptr](#) = `std::shared_ptr< FESpace< N, Q, S >>`

## 7.5 lib/include/FESpace\_imp.hpp File Reference

### Namespaces

- namespace [Tspeed](#)

## 7.6 lib/include/Force.hpp File Reference

```
#include <functional>
#include <Eigen/SparseCore>
#include "Receivers.hpp"
#include "FESpace.hpp"
#include <array>
#include "Force_imp.hpp"
```

### Classes

- class [Tspeed::Force](#)
- class [Tspeed::PointWiseForce](#)

### Namespaces

- namespace [Tspeed](#)

## 7.7 lib/include/Force\_imp.hpp File Reference

```
#include "Force.hpp"
```

### Namespaces

- namespace [Tspeed](#)

## 7.8 lib/include/Geometry.hpp File Reference

```
#include <array>
#include <cmath>
#include <Eigen/Dense>
#include <memory>
#include <limits>
#include <iostream>
```

### Classes

- class [Tspeed::Entity](#)
- class [Tspeed::Geo::Point](#)
- class [Tspeed::Geo::Edge](#)
- class [Tspeed::Geo::Triangle](#)

### Namespaces

- namespace [Tspeed](#)
- namespace [Tspeed::Geo](#)

## Enumerations

- enum [Tspeed::Bc](#) { [Tspeed::Dirichlet](#), [Tspeed::Neumann](#), [Tspeed::Internal](#), [Tspeed::Unassigned](#) }

## Functions

- std::ostream & [Tspeed::Geo::operator<<](#) (std::ostream &, Triangle const &)
- std::ostream & [Tspeed::Geo::operator<<](#) (std::ostream &, Point const &)

## Variables

- const unsigned int [NVAL](#) =std::numeric\_limits<unsigned int>::max()

### 7.8.1 Variable Documentation

7.8.1.1 const unsigned int [NVAL](#) =std::numeric\_limits<unsigned int>::max()

## 7.9 lib/include/Matrices\_imp.hpp File Reference

### Namespaces

- namespace [Tspeed](#)

## 7.10 lib/include/Mesh.hpp File Reference

```
#include <string>
#include <fstream>
#include <iostream>
#include <algorithm>
#include <map>
#include <Eigen/StdVector>
#include "Geometry.hpp"
```

### Classes

- class [Tspeed::Mesh](#)

### Namespaces

- namespace [Tspeed](#)

### Typedefs

- typedef std::shared\_ptr< Mesh > [Tspeed::Mesh\\_ptr](#)

## 7.11 lib/include/MyMat.hpp File Reference

```
#include <Eigen/Dense>
#include <vector>
#include "Mesh.hpp"
#include <fstream>
```

### Classes

- class [Tspeed::BaseMat](#)
- class [Tspeed::MyMatBlockDiag](#)
- class [Tspeed::MyMat](#)
- class [Tspeed::MyMatMultiDim< T >](#)
- class [Tspeed::MyMatMultiDimBlockDiag< T >](#)

### Namespaces

- namespace [Tspeed](#)

### Functions

- MyMat [Tspeed::operator\\*](#) (double const &c, MyMat const &M)
- Eigen::VectorXd [Tspeed::operator\\*](#) (MyMat const &, Eigen::VectorXd const &)
- Eigen::VectorXd [Tspeed::operator\\*](#) (MyMatBlockDiag const &, Eigen::VectorXd const &)
- MyMat [Tspeed::operator+](#) (MyMat a, MyMat const &b)
- MyMat [Tspeed::operator+](#) (MyMat a, MyMatBlockDiag const &b)

## 7.12 lib/include/QuadratureRule.hpp File Reference

```
#include <Eigen/Dense>
#include <limits>
#include <iostream>
#include "Geometry.hpp"
#include "Dunavant.hpp"
#include "QuadratureRule_imp.hpp"
```

### Classes

- class [Tspeed::QuadratureRule< N >](#)
- class [Tspeed::Gauss< N >](#)
- class [Tspeed::Dunavant< N >](#)

### Namespaces

- namespace [Tspeed](#)

## 7.13 lib/include/QuadratureRule\_imp.hpp File Reference

### Namespaces

- namespace [Tspeed](#)

### Functions

- template<int N>  
constexpr int [Tspeed::dunavant\\_num\\_points](#) ()

## 7.14 lib/include/Receivers.hpp File Reference

```
#include <string>
#include "Geometry.hpp"
#include "FESpace.hpp"
#include <fstream>
#include <vector>
#include "Receivers_imp.hpp"
```

### Classes

- class [Tspeed::PointWiseEntity](#)
- class [Tspeed::Receivers](#)

### Namespaces

- namespace [Tspeed](#)

## 7.15 lib/include/Receivers\_imp.hpp File Reference

```
#include "Receivers.hpp"
```

### Namespaces

- namespace [Tspeed](#)

## 7.16 lib/include/ShapeFunctions.hpp File Reference

```
#include <functional>
#include <vector>
#include <Eigen/Dense>
#include "ShapeFunctions_imp.hpp"
```

## Classes

- class [Tspeed::ShapeFunction< N >](#)
- class [Tspeed::Dubiner< N >](#)
- class [Tspeed::BoundaryAdapted< N >](#)

## Namespaces

- namespace [Tspeed](#)

## 7.17 lib/include/ShapeFunctions\_imp.hpp File Reference

### Namespaces

- namespace [Tspeed](#)

### Functions

- `Eigen::ArrayXd Tspeed::jacobi\_polynomial (int N, int alpha, int beta, Eigen::ArrayXd const &z)`

## 7.18 lib/include/TimeAdvance.hpp File Reference

```
#include <Eigen/SparseCore>
#include <Eigen/Dense>
#include "FESpace.hpp"
#include "Receivers.hpp"
#include "Geometry.hpp"
#include "Force.hpp"
#include "MyMat.hpp"
#include <memory>
#include <limits>
#include "Matrices_imp.hpp"
#include "TimeAdvance_imp.hpp"
```

## Classes

- class [Tspeed::Matrices](#)
- class [Tspeed::TimeAdvance](#)
- class [Tspeed::LeapFrog](#)

## Namespaces

- namespace [Tspeed](#)

### Functions

- `double Tspeed::mat\_dot (Eigen::Matrix2d const &a, Eigen::Matrix2d const &b)`
- `Eigen::Matrix2d Tspeed::CTensorProduct (Eigen::Matrix2d const &A, double lambda, double mu)`

## 7.19 lib/include/TimeAdvance\_imp.hpp File Reference

```
#include "TimeAdvance.hpp"
```

### Namespaces

- namespace [Tspeed](#)

## 7.20 lib/include/TSPEED.hpp File Reference

```
#include "QuadratureRule.hpp"  
#include "ShapeFunctions.hpp"  
#include "FESpace.hpp"  
#include "Mesh.hpp"  
#include "Receivers.hpp"  
#include "Force.hpp"  
#include "TimeAdvance.hpp"  
#include "MyMat.hpp"
```

## 7.21 TSPEED.hpp File Reference

```
#include "QuadratureRule.hpp"  
#include "ShapeFunctions.hpp"  
#include "FESpace.hpp"  
#include "Mesh.hpp"  
#include "Receivers.hpp"  
#include "Force.hpp"  
#include "TimeAdvance.hpp"  
#include "MyMat.hpp"
```

## 7.22 lib/src/Dunavant.cpp File Reference

```
#include <cstdlib>  
#include <iostream>  
#include <fstream>  
#include <iomanip>  
#include <cmath>  
#include <ctime>  
#include <cstring>  
#include "Dunavant.hpp"
```

### Macros

- #define [TIME\\_SIZE](#) 40
- #define [TIME\\_SIZE](#) 40



## Functions

- int [dunavant\\_degree](#) (int rule)
- int [dunavant\\_order\\_num](#) (int rule)
- void [dunavant\\_rule](#) (int rule, int order\_num, double xy[], double w[])
- int [dunavant\\_rule\\_num](#) ()
- int \* [dunavant\\_suborder](#) (int rule, int suborder\_num)
- int [dunavant\\_suborder\\_num](#) (int rule)
- void [dunavant\\_subrule](#) (int rule, int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_01](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_02](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_03](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_04](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_05](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_06](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_07](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_08](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_09](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_10](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_11](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_12](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_13](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_14](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_15](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_16](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_17](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_18](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_19](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [dunavant\\_subrule\\_20](#) (int suborder\_num, double suborder\_xyz[], double suborder\_w[])
- void [file\\_name\\_inc](#) (char \*file\_name)
- int [i4\\_max](#) (int i1, int i2)
- int [i4\\_min](#) (int i1, int i2)
- int [i4\\_modp](#) (int i, int j)
- int [i4\\_wrap](#) (int ival, int ilo, int ihi)
- double [r8\\_huge](#) ()
- int [r8\\_nint](#) (double x)
- void [reference\\_to\\_physical\\_t3](#) (double t[], int n, double ref[], double phy[])
- int [s\\_len\\_trim](#) (char \*s)
- void [timestamp](#) ()
- char \* [timestring](#) ()
- double [triangle\\_area](#) (double t[2 \* 3])
- void [triangle\\_points\\_plot](#) (char \*file\_name, double node\_xy[], int node\_show, int point\_num, double point\_xy[], int point\_show)

### 7.22.1 Macro Definition Documentation

7.22.1.1 `#define TIME_SIZE 40`

7.22.1.2 `#define TIME_SIZE 40`

### 7.22.2 Function Documentation

7.22.2.1 `int dunavant_degree ( int rule )`

7.22.2.2 int dunavant\_order\_num ( int rule )

7.22.2.3 void dunavant\_rule ( int rule, int order\_num, double xy[], double w[] )

7.22.2.4 int dunavant\_rule\_num ( void )

7.22.2.5 int\* dunavant\_suborder ( int rule, int suborder\_num )

7.22.2.6 int dunavant\_suborder\_num ( int rule )

7.22.2.7 void dunavant\_subrule ( int rule, int suborder\_num, double suborder\_xyz[], double suborder\_w[] )

7.22.2.8 void dunavant\_subrule\_01 ( int suborder\_num, double suborder\_xyz[], double suborder\_w[] )

7.22.2.9 void dunavant\_subrule\_02 ( int suborder\_num, double suborder\_xyz[], double suborder\_w[] )

7.22.2.10 void dunavant\_subrule\_03 ( int suborder\_num, double suborder\_xyz[], double suborder\_w[] )

7.22.2.11 void dunavant\_subrule\_04 ( int suborder\_num, double suborder\_xyz[], double suborder\_w[] )

7.22.2.12 void dunavant\_subrule\_05 ( int suborder\_num, double suborder\_xyz[], double suborder\_w[] )

7.22.2.13 void dunavant\_subrule\_06 ( int suborder\_num, double suborder\_xyz[], double suborder\_w[] )

7.22.2.14 void dunavant\_subrule\_07 ( int suborder\_num, double suborder\_xyz[], double suborder\_w[] )

7.22.2.15 void dunavant\_subrule\_08 ( int suborder\_num, double suborder\_xyz[], double suborder\_w[] )

7.22.2.16 void dunavant\_subrule\_09 ( int suborder\_num, double suborder\_xyz[], double suborder\_w[] )

7.22.2.17 void dunavant\_subrule\_10 ( int suborder\_num, double suborder\_xyz[], double suborder\_w[] )

7.22.2.18 void dunavant\_subrule\_11 ( int suborder\_num, double suborder\_xyz[], double suborder\_w[] )

7.22.2.19 void dunavant\_subrule\_12 ( int suborder\_num, double suborder\_xyz[], double suborder\_w[] )

7.22.2.20 void dunavant\_subrule\_13 ( int suborder\_num, double suborder\_xyz[], double suborder\_w[] )

7.22.2.21 void dunavant\_subrule\_14 ( int suborder\_num, double suborder\_xyz[], double suborder\_w[] )

7.22.2.22 void dunavant\_subrule\_15 ( int suborder\_num, double suborder\_xyz[], double suborder\_w[] )

7.22.2.23 void dunavant\_subrule\_16 ( int suborder\_num, double suborder\_xyz[], double suborder\_w[] )

7.22.2.24 void dunavant\_subrule\_17 ( int suborder\_num, double suborder\_xyz[], double suborder\_w[] )

7.22.2.25 void dunavant\_subrule\_18 ( int suborder\_num, double suborder\_xyz[], double suborder\_w[] )

7.22.2.26 void dunavant\_subrule\_19 ( int suborder\_num, double suborder\_xyz[], double suborder\_w[] )

7.22.2.27 void dunavant\_subrule\_20 ( int suborder\_num, double suborder\_xyz[], double suborder\_w[] )

7.22.2.28 void file\_name\_inc ( char \* file\_name )

7.22.2.29 int i4\_max ( int i1, int i2 )

7.22.2.30 `int i4_min ( int i1, int i2 )`

7.22.2.31 `int i4_modp ( int i, int j )`

7.22.2.32 `int i4_wrap ( int ival, int ilo, int ihi )`

7.22.2.33 `double r8_huge ( void )`

7.22.2.34 `int r8_nint ( double x )`

7.22.2.35 `void reference_to_physical_t3 ( double t[], int n, double ref[], double phy[] )`

7.22.2.36 `int s_len_trim ( char * s )`

7.22.2.37 `void timestamp ( void )`

7.22.2.38 `char* timestring ( void )`

7.22.2.39 `double triangle_area ( double t[2*3] )`

7.22.2.40 `void triangle_points_plot ( char * file_name, double node_xy[], int node_show, int point_num, double point_xy[], int point_show )`

## 7.23 lib/src/Force.cpp File Reference

```
#include "Force.hpp"
```

### Namespaces

- namespace [Tspeed](#)

## 7.24 lib/src/Geometry.cpp File Reference

```
#include "Geometry.hpp"
```

### Namespaces

- namespace [Tspeed](#)
- namespace [Tspeed::Geo](#)

### Functions

- `std::ostream & Tspeed::Geo::operator<< (std::ostream &, Point const &)`
- `Point Tspeed::Geo::operator- (const Point &a, const Point &b)`
- `Point Tspeed::Geo::operator- (const Eigen::Vector2d &a, const Point &b)`
- `Point Tspeed::Geo::operator- (const Point &a, const Eigen::Vector2d &b)`
- `Point Tspeed::Geo::operator+ (const Eigen::Vector2d &a, const Point &b)`
- `Point Tspeed::Geo::operator+ (const Point &a, const Eigen::Vector2d &b)`
- `Point Tspeed::Geo::operator+ (const Point &a, const Point &b)`
- `Point Tspeed::Geo::operator\* (const double &d, const Point &p)`
- `std::ostream & Tspeed::Geo::operator<< (std::ostream &, Triangle const &)`

## 7.25 lib/src/Mesh.cpp File Reference

```
#include "Mesh.hpp"
```

### Namespaces

- namespace [Tspeed](#)

## 7.26 lib/src/MyMat.cpp File Reference

```
#include "MyMat.hpp"
```

### Namespaces

- namespace [Tspeed](#)

### Functions

- `Eigen::VectorXd Tspeed::operator\* (MyMatMultiDimBlockDiag< MyMatBlockDiag > const &A, Eigen::VectorXd const &v)`
- `Eigen::VectorXd Tspeed::operator\* (MyMatMultiDim< MyMat > &A, Eigen::VectorXd const &v)`
- `Eigen::VectorXd Tspeed::operator\* (MyMatMultiDim< MyMatBlockDiag > &A, Eigen::VectorXd const &v)`
- `MyMat Tspeed::operator\* (double const &c, MyMat const &M)`
- `MyMatMultiDim< MyMat > Tspeed::operator+ (MyMatMultiDim< MyMat > const &a, MyMatMultiDim< MyMat > const &b)`
- `MyMatMultiDim< MyMat > Tspeed::operator+ (MyMatMultiDim< MyMat > const &a, MyMatMultiDim< MyMatBlockDiag > const &b)`
- `MyMat Tspeed::operator+ (MyMatBlockDiag const &b, MyMat a)`
- `MyMat Tspeed::operator+ (MyMat a, MyMatBlockDiag const &b)`
- `MyMat Tspeed::operator+ (MyMat a, MyMat const &b)`
- `Eigen::VectorXd Tspeed::operator\* (MyMatBlockDiag const &, Eigen::VectorXd const &)`
- `Eigen::VectorXd Tspeed::operator\* (MyMat const &, Eigen::VectorXd const &)`

## 7.27 lib/src/Parameters.cpp File Reference

```
#include "FESpace.hpp"
```

### Namespaces

- namespace [Tspeed](#)

## 7.28 lib/src/QuadratureRule.cpp File Reference

## 7.29 lib/src/Receivers.cpp File Reference

```
#include "Receivers.hpp"
```

### Namespaces

- namespace [Tspeed](#)

## 7.30 lib/src/ShapeFunctions.cpp File Reference

```
#include "ShapeFunctions.hpp"
```

### Typedefs

- typedef Eigen::ArrayXd [Arr](#)

### 7.30.1 Typedef Documentation

7.30.1.1 typedef Eigen::ArrayXd Arr

## 7.31 lib/src/TimeAdvance.cpp File Reference

```
#include "TimeAdvance.hpp"
```

### Namespaces

- namespace [Tspeed](#)

### Functions

- Eigen::Matrix2d [Tspeed::CTensorProduct](#) (Eigen::Matrix2d const &A, double lambda, double mu)
- double [Tspeed::mat\\_dot](#) (Eigen::Matrix2d const &a, Eigen::Matrix2d const &b)

## 7.32 main.cpp File Reference

```
#include "Dunavant.hpp"  
#include <iostream>
```

### Functions

- int [main](#) ()

### 7.32.1 Function Documentation

7.32.1.1 `int main ( )`

## 7.33 MATLAB\_files/load\_and\_plot.m File Reference

### Functions

- `function load_and_plot` (fn, startrecvs, numrecvs, start) if nargin
- `subplot` (2, 1, 1)
- `title` ('u\_x')
- `xlabel` ('t')
- `plot` (t(:), a{i}(:, 1)\*3+j \*ofsx,'r','LineWidth', 1.5)
- end hold off axis tight `set` (gca,'YTick', linspace(1 \*ofsx, numrecvs \*ofsx, floor(numrecvs/2)))
- `set` (gca,'YTickLabel', num2cell(1:2:numrecvs))
- `set` (findall(gcf,'type','text'),'fontSize', 14)
- `set` (gca, 'fontsize', 14) `subplot`(2
- `title` ('u\_y')
- `plot` (t(:), a{i}(:, 2)\*3+j \*ofsy,'k','LineWidth', 1.5)
- end `set` (gca,'YTick', linspace(1 \*ofsy, numrecvs \*ofsy, floor(numrecvs/2)))

### Variables

- end `ofsx` = 0
- `ofsy` = 0
- for `i`
- `a {i}`=load(fname)
- `myofsx` = max(a{i}(:,1))
- `myofsy` = max(a{i}(:,2))
- end end `t` = linspace(0,1,length(a{end}{:,1}))
- `figure`
- hold `on`

### 7.33.1 Function Documentation

7.33.1.1 `function load_and_plot ( fn , startrecvs , numrecvs , start )`

7.33.1.2 `plot ( t(:) , a{i}(:, 1)*3+j * ofsx , 'r' , 'LineWidth' , 1.5 )`

7.33.1.3 `plot ( t(:) , a{i}(:, 2)*3+j * ofsy , 'k' , 'LineWidth' , 1.5 )`

7.33.1.4 `end hold off axis tight set ( gca , 'YTick' , linspace(1 *ofsx, numrecvs *ofsx, floor(numrecvs/2)) )`

7.33.1.5 `set ( gca , 'YTickLabel' , num2cell(1:2:numrecvs) )`

7.33.1.6 `set ( findall(gcf,'type','text') , 'fontSize' , 14 )`

7.33.1.7 `set ( gca , 'fontsize' , 14 )`

7.33.1.8 `end set ( gca , 'YTick' , linspace(1 *ofsy, numrecvs *ofsy, floor(numrecvs/2)) )`

7.33.1.9 `subplot ( 2 , 1 , 1 )`

7.33.1.10 `title('u_x')`

7.33.1.11 `title('u_y')`

7.33.1.12 `xlabel('t')`

## 7.33.2 Variable Documentation

7.33.2.1 `a{i}=load(fname)`

7.33.2.2 `figure`

7.33.2.3 `if i`

**Initial value:**

```
=startrecvs:numrecvs+startrecvs-1
fname = sprintf('%s_rcv_%i.out',fn, i-1)
```

7.33.2.4 `myofsx = max(a{i}(:,1))`

7.33.2.5 `myofsy = max(a{i}(:,2))`

7.33.2.6 `end if myofsx ofsx ofsx = 0`

7.33.2.7 `if myofsy ofsy ofsy = 0`

7.33.2.8 `hold on`

7.33.2.9 `end end t = linspace(0,1,length(a{end}(:,1)))`

## 7.34 MATLAB\_files/load\_and\_plot\_lamb.m File Reference

### Functions

- `a(1:start-1,:)`
- `b(1:start-1,:)`
- `figure plot(linspace(0, 1, length(a(1:end, 1))), a(1:end, 1),'k--')`
- `plot(linspace(0, 1, length(b(1:end, 1))), b(1:end, 1),'r')`
- `set(gca, 'Ytick',[1])`
- `title('u_x')`
- `legend('r_1','r_2', 'location', 'best') set(findall(gcf`
- `set(gca, 'fontsize', 14)%legend boxoff figure hold on`
- `plot(linspace(0, 1, length(a(1:end, 1))), a(1:end, 2),'k--')`
- `plot(linspace(0, 1, length(b(1:end, 1))), b(1:end, 2),'r')`
- `xlabel('t')`
- `title('u_y')`

### Variables

- `function [a, b]`
- `end for i`
- `a{i}=load(fname0)`

- `b = load(fname1)`
- hold on
- type
- text
- fontSize

### 7.34.1 Function Documentation

7.34.1.1 `a ( 1:start- 1, : )`

7.34.1.2 `b ( 1:start- 1, : )`

7.34.1.3 `legend ( 'r_1', 'r_2', 'location', 'best' )`

7.34.1.4 `figure plot ( linspace(0, 1, length(a(1:end, 1))), a(1:end, 1), 'k--' )`

7.34.1.5 `plot ( linspace(0, 1, length(b(1:end, 1))), b(1:end, 1), 'r' )`

7.34.1.6 `plot ( linspace(0, 1, length(a(1:end, 1))), a(1:end, 2), 'k--' )`

7.34.1.7 `plot ( linspace(0, 1, length(b(1:end, 1))), b(1:end, 2), 'r' )`

7.34.1.8 `set ( gca, 'Ytick' )`

7.34.1.9 `set ( gca, 'fontsize', 14 )`

7.34.1.10 `title ( 'u_x' )`

7.34.1.11 `title ( 'u_y' )`

7.34.1.12 `xlabel ( 't' )`

### 7.34.2 Variable Documentation

7.34.2.1 `a {i} = load(fname0)`

7.34.2.2 `b = load(fname1)`

7.34.2.3 `fontSize`

7.34.2.4 `function[a, b]`

#### Initial value:

```
= load_and_plot(fname,numrecvs, start)

if nargin==1
    start = 0
```

7.34.2.5 end for i

#### Initial value:

```
=1:numrecvs
fname = sprintf('%s_rcv_%i.out',fname, i-1)
```



7.34.2.6 hold on

7.34.2.7 text

7.34.2.8 type

## 7.35 MATLAB\_files/plot\_seismogram.m File Reference

### Functions

- `function plot_seismogram (r, dt) nr`
- `subplot (2, 1, 1)`
- end hold off axis tight `set (gca,'YTick', linspace(1 *ofs, nr *ofs, nr))`
- `set (gca,'YTickLabel', num2cell(1:nr))`
- `subplot (2, 1, 2)`

### Variables

- `ns = length(r(1,:,1))`
- `t = 2*dt:dt:dt*(ns+1)`
- `ofs = max(max(max(r)))/2`
- `figure`
- hold on
- for i

### 7.35.1 Function Documentation

7.35.1.1 `function plot_seismogram ( r , dt )`

7.35.1.2 end axis tight `set ( gca , 'YTick' , linspace(1 *ofs, nr *ofs, nr) )`

7.35.1.3 `set ( gca , 'YTickLabel' , num2cell(1:nr) )`

7.35.1.4 `subplot ( 2 , 1 , 1 )`

7.35.1.5 `subplot ( 2 , 1 , 2 )`

### 7.35.2 Variable Documentation

7.35.2.1 `figure`

7.35.2.2 for i

#### Initial value:

```
=1:nr
plot(t(:), r(1,:,i)+i*ofs, 'r', 'LineWidth', 2)
```

7.35.2.3 `ns = length(r(1,:,1))`

7.35.2.4 `ofs = max(max(max(r)))/2`

7.35.2.5 hold on

7.35.2.6  $t = 2*dt:dt:dt*(ns+1)$

## 7.36 MATLAB\_files/vtk\_mesh\_out.m File Reference

### Functions

- `fprintf(fid, '#vtk DataFile Version 2.0\n')`
- `fprintf(fid, 'Comment\n')`
- `fprintf(fid, 'ASCII\n')`
- `fprintf(fid, 'DATASET UNSTRUCTURED_GRID\n')`
- `fprintf(fid, 'POINTS%i float\n', length(x))`
- `fprintf(fid, 'CELLS%i%i\n', numtria, 4 * numtria)`
- `end fprintf(fid, 'CELL_TYPES%i\n', numtria)`
- `end fprintf(fid, 'CELL_DATA%i\n', numtria)`
- `fprintf(fid, 'SCALARS%s float 1\n', varargin{i})`
- `fprintf(fid, 'LOOKUP_TABLE default\n')`
- `if length(par) > 1 for j`
- `end end end fclose(fid)`

### Variables

- `function vtk_mesh_out(femregion,`  
`dir, varargin)%usage x = femregion.coord(:,1)`
- `y = femregion.coord(:,2)`
- `tri = femregion.connectivity(1:3,:)-1`
- `fid = fopen(fname, 'w')`
- `for i`
- `end numtria = length(tri(:,1))`
- `end else for j`

### 7.36.1 Function Documentation

7.36.1.1 `end end end fclose ( fid )`

7.36.1.2 `fprintf ( fid , '#vtk DataFile Version 2.0\n' )`

7.36.1.3 `fprintf ( fid , 'Comment\n' )`

7.36.1.4 `fprintf ( fid , 'ASCII\n' )`

7.36.1.5 `fprintf ( fid , 'DATASET UNSTRUCTURED_GRID\n' )`

7.36.1.6 `fprintf ( fid , 'POINTS%i float\n', length(x) )`

7.36.1.7 `fprintf ( fid , 'CELLS%i%i\n', numtria , 4 * numtria )`

7.36.1.8 `end fprintf ( fid , 'CELL_TYPES%i\n', numtria )`

7.36.1.9 `end fprintf ( fid , 'CELL_DATA%i\n', numtria )`

7.36.1.10 `fprintf ( fid , 'SCALARS%s float 1\n', varargin{i} )`

7.36.1.11 `fprintf ( fid , 'LOOKUP_TABLE default\n' )`

7.36.1.12 `if length ( par )`

## 7.36.2 Variable Documentation

7.36.2.1 `fid = fopen(fname, 'w')`

7.36.2.2 `for i`

**Initial value:**

```
=1:length(x)
    fprintf(fid, '%g %g 0\n', x(i), y(i))
```

7.36.2.3 `end else for j`

**Initial value:**

```
=1:numtria
    fprintf(fid, '%g\n', par)
```

7.36.2.4 `end numtria = length(tri(:,1))`

7.36.2.5 `tri = femregion.connectivity(1:3,:)-1`

7.36.2.6 `function vtk_mesh_out (femregion, dir, varargin) %usage x = femregion.coord(:,1)`

7.36.2.7 `y = femregion.coord(:,2)`

## 7.37 MATLAB\_files/vtk\_output.m File Reference

### Functions

- `function vtk_output` (filename, folder, step, endstep) points
- else `vtk_vector_out` (fnameout, points(:, 1), points(:, 2), `uh_rec`, `tri`)

### Variables

- `for i`
- `fnamein` = `sprintf('%s_fieldu_%i.field', filename, i)`
- `uh_rec` = `load(fnamein)`

### 7.37.1 Function Documentation

7.37.1.1 `function vtk_output ( filename , folder , step , endstep )`

7.37.1.2 `else vtk_vector_out ( fnameout , points(:, 1) , points(:, 2) , uh_rec , tri )`

### 7.37.2 Variable Documentation

7.37.2.1 `fnamein` = `sprintf('%s_fieldu_%i.field', filename, i)`

### 7.37.2.2 if i

#### Initial value:

```
=0:step:endstep
    fnameout = sprintf('%s/field%i.vtk', folder, i)
```

### 7.37.2.3 uh\_rec = load(fnamein)

## 7.38 MATLAB\_files/vtk\_vector\_out.m File Reference

### Functions

- `fprintf(fid, '#vtk DataFile Version 2.0\n')`
- `fprintf(fid, 'Comment\n')`
- `fprintf(fid, 'ASCII\n')`
- `fprintf(fid, 'DATASET UNSTRUCTURED_GRID\n')`
- `fprintf(fid, 'POINTS%i float\n', length(x))`

### Variables

- `function [tri]`
- `for i`

### 7.38.1 Function Documentation

7.38.1.1 `fprintf( fid , '#vtk DataFile Version 2.0\n' )`

7.38.1.2 `fprintf( fid , 'Comment\n' )`

7.38.1.3 `fprintf( fid , 'ASCII\n' )`

7.38.1.4 `fprintf( fid , 'DATASET UNSTRUCTURED_GRID\n' )`

7.38.1.5 `fprintf( fid , 'POINTS%i float\n', length(x) )`

### 7.38.2 Variable Documentation

7.38.2.1 `function[tri]`

#### Initial value:

```
= vtk_vector_out(fname, x, y, v, tri)
```

```
fid = fopen(fname, 'w')
```

7.38.2.2 `for i`

#### Initial value:

```
=1:length(x)
    fprintf(fid, '%g %g 0\n', x(i), y(i))
```

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