Operator terms

Zero-Order-Terms	
$\langle c\ \phi, \psi\rangle$	`Simple_ZOT`$([c \in \mathbb{R}])$
$\langle f(\vec{x})\ \phi, \psi\rangle$	`CoordsAtQP_ZOT`$(f : \mathbb{R}^n \to \mathbb{R})$
$\langle f(v)\ \phi, \psi\rangle$	`VecAtQP_ZOT`$(v \in$DOFVector$\langle\mathbb{R}\rangle$, $[f : \mathbb{R} \to \mathbb{R}])$
$\langle f(v, \vec{x})\ \phi, \psi\rangle$	`VecAndCoordsAtQP_ZOT`$(v \in$DOFVector$\langle\mathbb{R}\rangle$, $f : \mathbb{R} \times \mathbb{R}^n \to \mathbb{R})$
$\langle f(v)\ g(w)\ \phi, \psi\rangle$	`MultVecAtQP_ZOT`$(v, w \in$DOFVector$\langle\mathbb{R}\rangle$, $f : \mathbb{R} \to \mathbb{R}$, $g : \mathbb{R} \to \mathbb{R})$
$\langle f(v, w)\ \phi, \psi\rangle$	`Vec2AtQP_ZOT`$(v, w \in$DOFVector$\langle\mathbb{R}\rangle$, $[f : (\mathbb{R})^2 \to \mathbb{R}])$
$\langle f(v_1, v_2, v_3)\ \phi, \psi\rangle$	`Vec3AtQP_ZOT`$(v_1, v_2, v_3 \in$DOFVector$\langle\mathbb{R}\rangle$, $[f : (\mathbb{R})^3 \to \mathbb{R}])$
$\langle f(\nabla v)\ \phi, \psi\rangle$	`FctGradient_ZOT`$(v \in$DOFVector$\langle\mathbb{R}\rangle$, $f : \mathbb{R}^n \to \mathbb{R})$
$\langle f(\nabla v, \vec{x})\ \phi, \psi\rangle$	`FctGradientCoords_ZOT`$(v \in$DOFVector$\langle\mathbb{R}\rangle$, $f : \mathbb{R}^n \times \mathbb{R}^n \to \mathbb{R})$
$\langle f(v, \nabla v)\ \phi, \psi\rangle$	`VecAndGradAtQP_ZOT`$(v \in$DOFVector$\langle\mathbb{R}\rangle$, $f : \mathbb{R} \times \mathbb{R}^n \to \mathbb{R})$
$\langle f(v, \nabla v, \vec{x})\ \phi, \psi\rangle$	`VecGradCoordsAtQP_ZOT`$(v \in$DOFVector$\langle\mathbb{R}\rangle$, $f : \mathbb{R} \times \mathbb{R}^n \times \mathbb{R}^n \to \mathbb{R})$
$\langle f(v, \nabla v, w)\ \phi, \psi\rangle$	`Vec2AndGradAtQP_ZOT`$(v, w \in$DOFVector$\langle\mathbb{R}\rangle$, $f : \mathbb{R} \times \mathbb{R}^n \times \mathbb{R} \to \mathbb{R})$
$\langle f(v, \nabla w)\ \phi, \psi\rangle$	`VecAndGradVecAtQP_ZOT`$(v, w \in$DOFVector$\langle\mathbb{R}\rangle$, $f : \mathbb{R} \times \mathbb{R}^n \to \mathbb{R})$
$\langle f(v_1, v_2 \nabla v_3)\ \phi, \psi\rangle$	`Vec2AndGradVecAtQP_ZOT`$(v_1, v_2, v_3 \in$DOFVector$\langle\mathbb{R}\rangle$, $f : \mathbb{R} \times \mathbb{R} \times \mathbb{R}^n \to \mathbb{R})$
$\langle f(v, \nabla w_1, \nabla w_2)\ \phi, \psi\rangle$	`VecAndGradVec2AtQP_ZOT`$(v, w_1, w_2 \in$DOFVector$\langle\mathbb{R}\rangle$, $f : \mathbb{R} \times \mathbb{R}^n \times \mathbb{R}^n \to \mathbb{R})$
$\langle f(v, w, \nabla v, \nabla w)\ \phi, \psi\rangle$	`Vec2AndGrad2AtQP_ZOT`$(v, w \in$DOFVector$\langle\mathbb{R}\rangle$, $f : \mathbb{R} \times \mathbb{R} \times \mathbb{R}^n \times \mathbb{R}^n \to \mathbb{R})$
$\langle f(\{v_i\}_i)\ \phi, \psi\rangle$	`VecOfDOFVecsAtQP_ZOT`(vec$\langle$DOFVector$\langle\mathbb{R}\rangle\rangle$, f :vec$\langle\mathbb{R}\rangle \to \mathbb{R})$
$\langle f(\{\nabla v_i\}_i)\ \phi, \psi\rangle$	`VecOfGradientsAtQP_ZOT`(vec$\langle$DOFVector$\langle\mathbb{R}\rangle\rangle$, f :vec$\langle\mathbb{R}^n\rangle \to \mathbb{R})$
$\langle f(v, \{\nabla w_i\}_i)\ \phi, \psi\rangle$	`VecAndVecOfGradientsAtQP_ZOT`$(v \in$DOFVector$\langle\mathbb{R}\rangle$,vec$\langle$DOFVector$\langle\mathbb{R}\rangle\rangle$, $f : \mathbb{R}\times$vec$\langle\mathbb{R}^n\rangle \to \mathbb{R})$
$\langle \partial_1 v_1\ [+\partial_2 v_2 + \partial_3 v_3]\ \phi, \psi\rangle$	`VecDivergence_ZOT`$(v_1\ [, v_2, v_3] \in$DOFVector$\langle\mathbb{R}\rangle)$
$\langle f(\vec{x}, \{v_i\}, \{\nabla w_j\})\ \phi, \psi\rangle$	`General_ZOT`(vec$\langle$DOFVector$\langle\mathbb{R}\rangle\rangle$,vec$\langle$DOFVector$\langle\mathbb{R}\rangle\rangle$, $f : \mathbb{R}^n\times$vec$\langle\mathbb{R}\rangle\times$vec$\langle\mathbb{R}^n\rangle \to \mathbb{R})$
$\langle f(\vec{x}, \vec{n}, \{v_i\}, \{\nabla w_j\})\ \phi, \psi\rangle$	`GeneralParametric_ZOT`(vec$\langle$DOFVector$\langle\mathbb{R}\rangle\rangle$,vec$\langle$DOFVector$\langle\mathbb{R}\rangle\rangle$, $f : \mathbb{R}^n \times \mathbb{R}^n\times$vec$\langle\mathbb{R}\rangle\times$vec$\langle\mathbb{R}^n\rangle \to \mathbb{R})$

First-Order-Terms		
GRD_PHI	GRD_PSI	
$\langle c\,\vec{1} \cdot \nabla\phi, \psi\rangle$	$\langle c\,\vec{1}\phi, \nabla\psi\rangle$	`Simple_FOT`$([c \in \mathbb{R}])$
$\langle c\,\vec{b} \cdot \nabla\phi, \psi\rangle$	$\langle c\,\vec{b}\phi, \nabla\psi\rangle$	`Vector_FOT`$(\{b \in \mathbb{R}^n \mid i \in \mathbb{N}\}$, $[c \in \mathbb{R}])$
$\langle f(v) \cdot \vec{b} \cdot \nabla\phi, \psi\rangle$	$\langle f(v) \cdot \vec{b}\phi, \nabla\psi\rangle$	`VecAtQP_FOT`$(v \in$DOFVector$\langle\mathbb{R}\rangle$, $f : \mathbb{R} \to \mathbb{R}$, $\{b \in \mathbb{R}^n \mid i \in \mathbb{N}\})$
$\langle f(v, w) \cdot \vec{b} \cdot \nabla\phi, \psi\rangle$	$\langle f(v, w) \cdot \vec{b}\phi, \nabla\psi\rangle$	`Vec2AtQP_FOT`$(v, w \in$DOFVector$\langle\mathbb{R}\rangle$, $f : (\mathbb{R})^2 \to \mathbb{R}$, $\{b \in \mathbb{R}^n \mid i \in \mathbb{N}\})$
$\langle f(v_1, v_2, v_3) \cdot \vec{b} \cdot \nabla\phi, \psi\rangle$	$\langle f(v_1, v_2, v_3) \cdot \vec{b}\phi, \nabla\psi\rangle$	`Vec3AtQP_FOT`$(v_1, v_2, v_3 \in$DOFVector$\langle\mathbb{R}\rangle$, $f : (\mathbb{R})^3 \to \mathbb{R}$, $\{b^* \in \mathbb{R}^n \mid i \in \mathbb{N}\})$
$\langle f(\vec{x}) \cdot \vec{1} \cdot \nabla\phi, \psi\rangle$	$\langle f(\vec{x}) \cdot \vec{1}\phi, \nabla\psi\rangle$	`CoordsAtQP_FOT`$(f : \mathbb{R}^n \to \mathbb{R})$
$\langle f(\vec{x}) \cdot \vec{b} \cdot \nabla\phi, \psi\rangle$	$\langle f(\vec{x}) \cdot \vec{b}\phi, \nabla\psi\rangle$	`VecCoordsAtQP_FOT`$(f : \mathbb{R}^n \to \mathbb{R}$, $b^* \in \mathbb{R}^n)$
$\langle f(\vec{x}, v) \cdot \vec{b} \cdot \nabla\phi, \psi\rangle$	$\langle f(\vec{x}, v) \cdot \vec{b}\phi, \nabla\psi\rangle$	`FctVecAtQP_FOT`$(v \in$DOFVector$\langle\mathbb{R}\rangle$, $f : \mathbb{R}^n \times \mathbb{R} \to \mathbb{R}$, $b^* \in \mathbb{R}^n)$
$\langle f(v, w, \nabla v) \cdot \vec{b} \cdot \nabla\phi, \psi\rangle$	$\langle f(v, w, \nabla v) \cdot \vec{b}\phi, \nabla\psi\rangle$	`Vec2AndGradAtQP_FOT`$(v, w \in$DOFVector$\langle\mathbb{R}\rangle$, $f : (\mathbb{R})^2 \times \mathbb{R}^n \to \mathbb{R}$, $b^* \in \mathbb{R}^n)$
$\langle F(\vec{x}) \cdot \nabla\phi, \psi\rangle$	$\langle F(\vec{x})\,\phi, \nabla\psi\rangle$	`VecFctAtQP_FOT`$(F : \mathbb{R}^n \to \mathbb{R}^n)$
$\langle F(v) \cdot \nabla\phi, \psi\rangle$	$\langle F(v)\,\phi, \nabla\psi\rangle$	`VectorFct_FOT`$(v \in$DOFVector$\langle\mathbb{R}\rangle$, $F : \mathbb{R} \to \mathbb{R}^n)$
$\langle F(\nabla v) \cdot \nabla\phi, \psi\rangle$	$\langle F(\nabla v)\,\phi, \nabla\psi\rangle$	`VectorGradient_FOT`$(v \in$DOFVector$\langle\mathbb{R}\rangle$, $F : \mathbb{R}^n \to \mathbb{R}^n)$
$\langle F(v, \nabla w) \cdot \nabla\phi, \psi\rangle$	$\langle F(v, \nabla w)\,\phi, \nabla\psi\rangle$	`VecGrad_FOT`$(v, w \in$DOFVector$\langle\mathbb{R}\rangle$, $F : \mathbb{R} \times \mathbb{R}^n \to \mathbb{R}^n)$
$\langle F(\nabla v, \nabla w) \cdot \nabla\phi, \psi\rangle$	$\langle F(\nabla v, \nabla w)\,\phi, \nabla\psi\rangle$	`FctGrad2_FOT`$(v, w \in$DOFVector$\langle\mathbb{R}\rangle$, $F : (\mathbb{R}^n)^2 \to \mathbb{R}^n)$
$\langle F(\vec{x}, \{v_i\}, \{\nabla w_j\}) \cdot \nabla\phi, \psi\rangle$	$\langle F(\vec{x}, \{v_i\}, \{\nabla w_j\})\,\phi, \nabla\psi\rangle$	`General_FOT`(vec$\langle$DOFVector$\langle\mathbb{R}\rangle\rangle$,vec$\langle$DOFVector$\langle\mathbb{R}\rangle\rangle$, $F : \mathbb{R}^n\times$vec$\langle\mathbb{R}\rangle\times$vec$\langle\mathbb{R}^n\rangle \to \mathbb{R}^n)$
$\langle F(\vec{x}, \vec{n}, \{v_i\}, \{\nabla w_j\}) \cdot \nabla\phi, \psi\rangle$	$\langle F(\vec{x}, \vec{n}, \{v_i\}, \{\nabla w_j\})\,\phi, \nabla\psi\rangle$	`GeneralParametric_FOT`(vec$\langle$DOFVector$\langle\mathbb{R}\rangle\rangle$,vec$\langle$DOFVector$\langle\mathbb{R}\rangle\rangle$, $F : \mathbb{R}^n \times \mathbb{R}^n\times$vec$\langle\mathbb{R}\rangle\times$vec$\langle\mathbb{R}^n\rangle \to \mathbb{R}^n)$

Second-Order-Terms	
$\langle c \cdot \nabla\phi, \nabla\psi\rangle$	`Simple_SOT`($[c \in \mathbb{R}]$)
$\langle f(\vec{x})\nabla\phi, \nabla\psi\rangle$	`CoordsAtQP_SOT`($f : \mathbb{R}^n \to \mathbb{R}$)
$\langle f(v)\nabla\phi, \nabla\psi\rangle$	`VecAtQP_SOT`($v \in$DOFVector$\langle\mathbb{R}\rangle$, $[f : \mathbb{R} \to \mathbb{R}]$)
$\langle f(v, \vec{x})\nabla\phi, \nabla\psi\rangle$	`VecAndCoordsAtQP_SOT`($v \in$DOFVector$\langle\mathbb{R}\rangle$, $f : \mathbb{R} \times \mathbb{R}^n \to \mathbb{R}$)
$\langle f(v, w)\nabla\phi, \nabla\psi\rangle$	`Vec2AtQP_SOT`($v, w \in$DOFVector$\langle\mathbb{R}\rangle$, $[f : \mathbb{R} \times \mathbb{R} \to \mathbb{R}]$)
$\langle f(\nabla v)\nabla\phi, \nabla\psi\rangle$	`FctGradient_SOT`($v \in$DOFVector$\langle\mathbb{R}\rangle$, $f : \mathbb{R}^n \to \mathbb{R}$)
$\langle f(v, \nabla v)\nabla\phi, \nabla\psi\rangle$	`VecAndGradAtQP_SOT`($v \in$DOFVector$\langle\mathbb{R}\rangle$, $f : \mathbb{R} \times \mathbb{R}^n \to \mathbb{R}$)
$\langle f(v, \nabla v, \vec{x})\nabla\phi, \nabla\psi\rangle$	`VecGradCoordsAtQP_SOT`($v \in$DOFVector$\langle\mathbb{R}\rangle$, $f : \mathbb{R} \times \mathbb{R}^n \times \mathbb{R}^n \to \mathbb{R}$)
$\langle f(v, \nabla w)\nabla\phi, \nabla\psi\rangle$	`VecGrad_SOT`($v, w \in$DOFVector$\langle\mathbb{R}\rangle$, $f : \mathbb{R} \times \mathbb{R}^n \to \mathbb{R}$)
$\langle c\,\partial_j(\phi), \partial_i(\psi)\rangle$	`FactorIJ_SOT`($i, j \in \mathbb{N}$, $c \in \mathbb{R}$)
$\langle f(\vec{x})\,\partial_j(\phi), \partial_i(\psi)\rangle$	`CoordsAtQP_IJ_SOT`($f : \mathbb{R}^n \to \mathbb{R}$, $i, j \in \mathbb{N}$)
$\langle f(v)\,\partial_j(\phi), \partial_i(\psi)\rangle$	`VecAtQP_IJ_SOT`($v \in$DOFVector$\langle\mathbb{R}\rangle$, $f : \mathbb{R} \to \mathbb{R}$, $i, j \in \mathbb{N}$)
$\langle f(v_1, v_2)\,\partial_j(\phi), \partial_i(\psi)\rangle$	`Vec2AtQP_IJ_SOT`($v_1, v_2 \in$DOFVector$\langle\mathbb{R}\rangle$, $f : \mathbb{R} \times \mathbb{R} \to \mathbb{R}$, $i, j \in \mathbb{N}$)
$\langle B\nabla\phi, \nabla\psi\rangle$	`Matrix_SOT`($B \in \mathbb{R}^{n\times n}$)
$\langle A(v)\nabla\phi, \nabla\psi\rangle$	`MatrixFct_SOT`($v \in$DOFVector$\langle\mathbb{R}\rangle$, $A : \mathbb{R} \to \mathbb{R}^{n\times n}$, $[div^*]$)
$\langle B \cdot f(v, w)\nabla\phi, \nabla\psi\rangle$	`MatrixVec2_SOT`($v, w \in$DOFVector$\langle\mathbb{R}\rangle$, $f : \mathbb{R} \times \mathbb{R} \to \mathbb{R}$, $B \in \mathbb{R}^{n\times n}$)
$\langle A(\nabla v)\nabla\phi, \nabla\psi\rangle$	`MatrixGradient_SOT`($v \in$DOFVector$\langle\mathbb{R}\rangle$, $A : \mathbb{R}^n \to \mathbb{R}^{n\times n}$, $[div^*]$)
$\langle A(v, \nabla v)\nabla\phi, \nabla\psi\rangle$	`VecMatrixGradientAtQP_SOT`($v \in$DOFVector$\langle\mathbb{R}\rangle$, $A : \mathbb{R} \times \mathbb{R}^n \to \mathbb{R}^{n\times n}$, $[div^*]$)
$\langle A(\nabla v, \vec{x})\nabla\phi, \nabla\psi\rangle$	`MatrixGradientAndCoords_SOT`($v \in$DOFVector$\langle\mathbb{R}\rangle$, $A : \mathbb{R}^n \times \mathbb{R}^n \to \mathbb{R}^{n\times n}$, $[div^*]$)
$\langle A(\vec{x}, \{v_i\}, \{\nabla w_j\})\nabla\phi, \nabla\psi\rangle$	`General_SOT`(vec$\langle$DOFVector$\langle\mathbb{R}\rangle\rangle$,vec$\langle$DOFVector$\langle\mathbb{R}\rangle\rangle$, $A : \mathbb{R}^n \times$vec$\langle\mathbb{R}\rangle\times$vec$\langle\mathbb{R}^n\rangle \to \mathbb{R}^{n\times n}$, $[div^*]$)
$\langle A(\vec{x}, \vec{n}, \{v_i\}, \{\nabla w_j\})\nabla\phi, \nabla\psi\rangle$	`GeneralParametric_SOT`(vec$\langle$DOFVector$\langle\mathbb{R}\rangle\rangle$,vec$\langle$DOFVector$\langle\mathbb{R}\rangle\rangle$, $A : \mathbb{R}^n \times \mathbb{R}^n \times$vec$\langle\mathbb{R}\rangle\times$vec$\langle\mathbb{R}^n\rangle \to \mathbb{R}^{n\times n}$, $[div^*]$)

Comments

- All operators are listed in the files `ZeroOrderTerm.h`, `FirstOrderTerm.h` and `SecondOrderTerm.h`.
- The following definitions/shortcuts are used to reduce typing: L_2-Scalar product: $\langle\cdot,\cdot\rangle$, trialfunction: ϕ, testfunction ψ, coefficients $c \in \mathbb{R}$, $\vec{1}, \vec{b}, \vec{x} \in \mathbb{R}^n$, with $(\vec{1})_i = 1$, $B \in \mathbb{R}^{n\times n}$, functors $f : (\ldots) \to \mathbb{R}$, $F : (\ldots) \to \mathbb{R}^n$ and $A : (\ldots) \to \mathbb{R}^{n\times n}$.
- Some mathematical notations are used to describe data-structures: $\mathbb{R}$ means `double`, $\mathbb{R}^n$ means `WorldVector<double>` and $\mathbb{R}^{n\times n}$ means `WorldMatrix<double>`.
- f, F, A can be implemented as `(*)AbstractFunction`$\langle$`ReturnType, InputType1, InputType2, ...`$\rangle$, where `(*)`$\in\{\emptyset$, `Binary`, `Tertiary`, `Quart`$\}$ depending on the number of input arguments.
- The data-structure `DOFVector<*>` is always a pointer to a DOFVector.
- Optional arguments are depicted in square brackets $[*]$, where constants $c = 1$ by default, functions are `NULL`-pointers by default and are treated as identity functors or simple multiplication functors.
- Alternative argument of the form $\{b \in \mathbb{R}^n \,|\, i \in \mathbb{N}\}$ mean in the second case: $\vec{b} := \vec{e}_i$.
- The expression $b^* \in \mathbb{R}^n$ means a pointer to a `WorldVector<double>`.
- The argument $div := \mathbb{R}^{n\times n} \to \mathbb{R}^n$ is only interesting for error estimators and optional. Is should implement the divergence of the matrix function in the operator.
- The argument vec$\langle*\rangle$ should be implemented as `std::vector`$\langle*\rangle$.
- In the last Second-Order-Operator `GeneralParametric_*OT`, the second argument $\vec{n}$ to the functor is the elementnormal, especially for surface meshes.