[](http://www.comsol.com/)

Ch4 Ex4.5 NLFourierSeries Burger exportdata

|  |  |
| --- | --- |
| Date | Apr 27, 2014 4:40:49 PM |

Contents

[1. Global](#cs4293199)

[1.1. Definitions](#cs6267361)

[2. Model 1](#cs6230786)

[2.1. Definitions](#cs4548885)

[2.2. Geometry 1](#cs1779022)

[2.3. Unit input](#cs3304006)

[2.4. Regulator Equation PI0](#cs8430517)

[2.5. Regulator Equation PI1](#cs7958614)

[2.6. Regulator Equation PI2](#cs3789319)

[2.7. Regulator Equation PI3](#cs5415236)

[2.8. Regulator Equation PI4](#cs2935891)

[2.9. Regulator Equation PI5](#cs2370535)

[2.10. Closed Loop System](#cs4528906)

[2.11. Mesh 1](#cs6488487)

[3. Study 1](#cs8896623)

[3.1. Stationary](#cs8012312)

[3.2. Solver Configurations](#cs7785939)

[4. Study 2](#cs8589692)

[4.1. Stationary](#cs3886453)

[4.2. Solver Configurations](#cs7622387)

[5. Study 3](#cs4925416)

[5.1. Time Dependent](#cs6871458)

[5.2. Solver Configurations](#cs9656718)

[6. Results](#cs9493139)

[6.1. Data Sets](#cs5462505)

[6.2. Derived Values](#cs8892682)

[6.3. Tables](#cs3997260)

[6.4. Plot Groups](#cs2428362)

1. Global

|  |  |
| --- | --- |
| Date | Oct 14, 2013 11:45:18 AM |

Global settings

|  |  |
| --- | --- |
| Name | Ch4 Ex4.5 NLFourierSeries Burger exportdata.mph |
| Path | /Users/gilliam/Desktop/collect\_15/research\_15/geo\_reg\_mono\_eugenio/Mono\_1\_15/Comsol\_EX\_GitHub/Chapter4/Example4.5/Ch4\_Ex4.5\_NLFourierSeries\_Burger\_exportdata.mph |
| Program | COMSOL 4.4 (Build: 150) |

Used products

|  |
| --- |
| COMSOL Multiphysics |

* 1. Definitions
     1. Parameters 1

Parameters

| **Name** | **Expression** | **Value** | **Description** |
| --- | --- | --- | --- |
| L | 1 | 1.0000 |  |
| x0 | 0.5 | 0.50000 |  |
| M1 | 0.5 | 0.50000 |  |
| A1 | 0.25 | 0.25000 |  |
| alpha | pi | 3.1416 |  |
| alpha1 | 2\*alpha | 6.2832 |  |
| M2 | 0.75 | 0.75000 |  |
| A2 | 1. | 1.0000 |  |
| alpha2 | alpha | 3.1416 |  |
| N | 5 | 5.0000 |  |

1. Model 1

Component settings

|  |  |
| --- | --- |
| Unit system | None |

* 1. Definitions
     1. Variables

#### Variables 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Entire model |

| **Name** | **Expression** | **Description** |
| --- | --- | --- |
| f\_a0 | -0.5\*d(0.5\*a0\*a0 + a1\*a1 + a2\*a2 + a3\*a3 + a4\*a4 + a5\*a5 + b1\*b1 + b2\*b2 + b3\*b3 + b4\*b4 + b5\*b5, x) |  |
| f\_a1 | -0.5\*d(a0\*a1 + 0.5\*a1\*a2 + 0.5\*a2\*a1 + 0.5\*a2\*a3 + 0.5\*a3\*a2 + 0.5\*a3\*a4 + 0.5\*a4\*a3 + 0.5\*a4\*a5 + 0.5\*a5\*a4 + 0.5\*b1\*b2 + 0.5\*b2\*b1 + 0.5\*b2\*b3 + 0.5\*b3\*b2 + 0.5\*b3\*b4 + 0.5\*b4\*b3 + 0.5\*b4\*b5 + 0.5\*b5\*b4, x)\*(N>0) |  |
| f\_b1 | -0.5\*d(a0\*b1 + a1\*b2 - a2\*b1 + a2\*b3 - a3\*b2 + a3\*b4 - a4\*b3 + a4\*b5 - a5\*b4, x)\*(N>0) |  |
| f\_a2 | -0.5\*d(a0\*a2 + 0.5\*a1\*a1 + 0.5\*a1\*a3 + 0.5\*a2\*a4 + 0.5\*a3\*a1 + 0.5\*a3\*a5 + 0.5\*a4\*a2 + 0.5\*a5\*a3 - 0.5\*b1\*b1 + 0.5\*b1\*b3 + 0.5\*b2\*b4 + 0.5\*b3\*b1 + 0.5\*b3\*b5 + 0.5\*b4\*b2 + 0.5\*b5\*b3, x)\*(N>1) |  |
| f\_b2 | -0.5\*d(a0\*b2 + a1\*b1 + a1\*b3 + a2\*b4 - a3\*b1 + a3\*b5 - a4\*b2 - a5\*b3, x)\*(N>1) |  |
| f\_a3 | -0.5\*d(a0\*a3 + 0.5\*a1\*a2 + 0.5\*a1\*a4 + 0.5\*a2\*a1 + 0.5\*a2\*a5 + 0.5\*a4\*a1 + 0.5\*a5\*a2 - 0.5\*b1\*b2 + 0.5\*b1\*b4 - 0.5\*b2\*b1 + 0.5\*b2\*b5 + 0.5\*b4\*b1 + 0.5\*b5\*b2, x)\*(N>2) |  |
| f\_b3 | -0.5\*d(a0\*b3 + a1\*b2 + a1\*b4 + a2\*b1 + a2\*b5 - a4\*b1 - a5\*b2, x)\*(N>2) |  |
| f\_a4 | -0.5\*d(a0\*a4 + 0.5\*a1\*a3 + 0.5\*a1\*a5 + 0.5\*a2\*a2 + 0.5\*a3\*a1 + 0.5\*a5\*a1 - 0.5\*b1\*b3 + 0.5\*b1\*b5 - 0.5\*b2\*b2 - 0.5\*b3\*b1 + 0.5\*b5\*b1, x)\*(N>3) |  |
| f\_b4 | -0.5\*d(a0\*b4 + a1\*b3 + a1\*b5 + a2\*b2 + a3\*b1 - a5\*b1, x)\*(N>3) |  |
| f\_a5 | -0.5\*d(a0\*a5 + 0.5\*a1\*a4 + 0.5\*a2\*a3 + 0.5\*a3\*a2 + 0.5\*a4\*a1 - 0.5\*b1\*b4 - 0.5\*b2\*b3 - 0.5\*b3\*b2 - 0.5\*b4\*b1, x)\*(N>4) |  |
| f\_b5 | -0.5\*d(a0\*b5 + a1\*b4 + a2\*b3 + a3\*b2 + a4\*b1, x)\*(N>4) |  |
| d\_a0 | 2\*M2 |  |
| d\_a1 | 0\*(N>0) |  |
| d\_b1 | A2\*(N>0) |  |
| d\_a2 | 0\*(N>1) |  |
| d\_b2 | 0\*(N>1) |  |
| d\_a3 | 0\*(N>2) |  |
| d\_b3 | 0\*(N>2) |  |
| d\_a4 | 0\*(N>3) |  |
| d\_b4 | 0\*(N>3) |  |
| d\_a5 | 0\*(N>4) |  |
| d\_b5 | 0\*(N>4) |  |
| d | M2 + A2\*sin(alpha2\*t) |  |
| Gamma\_a0 | (2\*M1 - C(at0))/G |  |
| Gamma\_a1 | (0 - C(at1))/G\*(N>0) |  |
| Gamma\_b1 | (0 - C(bt1))/G\*(N>0) |  |
| Gamma\_a2 | (0 - C(at2))/G\*(N>1) |  |
| Gamma\_b2 | (A1 - C(bt2))/G\*(N>1) |  |
| Gamma\_a3 | (0 - C(at3))/G\*(N>2) |  |
| Gamma\_b3 | (0 - C(bt3))/G\*(N>2) |  |
| Gamma\_a4 | (0 - C(at4))/G\*(N>3) |  |
| Gamma\_b4 | (0 - C(bt4))/G\*(N>3) |  |
| Gamma\_a5 | (0 - C(at5))/G\*(N>4) |  |
| Gamma\_b5 | (0 - C(bt5))/G\*(N>4) |  |
| yr | M1 + A1\*sin(alpha1\*t) |  |
| u | 0.5\*Gamma\_a0 + Gamma\_a1\*cos(alpha\*1\*t) + Gamma\_b1\*sin(alpha\*1\*t) + Gamma\_a2\*cos(alpha\*2\*t) + Gamma\_b2\*sin(alpha\*2\*t) + Gamma\_a3\*cos(alpha\*3\*t) + Gamma\_b3\*sin(alpha\*3\*t) + Gamma\_a4\*cos(alpha\*4\*t) + Gamma\_b4\*sin(alpha\*4\*t) + Gamma\_a5\*cos(alpha\*5\*t) + Gamma\_b5\*sin(alpha\*5\*t) |  |

#### Variables 2

Selection

|  |  |
| --- | --- |
| Geometric entity level | Entire model |

| **Name** | **Expression** | **Description** |
| --- | --- | --- |
| G | C(X) |  |
| e | yr - C(z) |  |

* + 1. Component Couplings

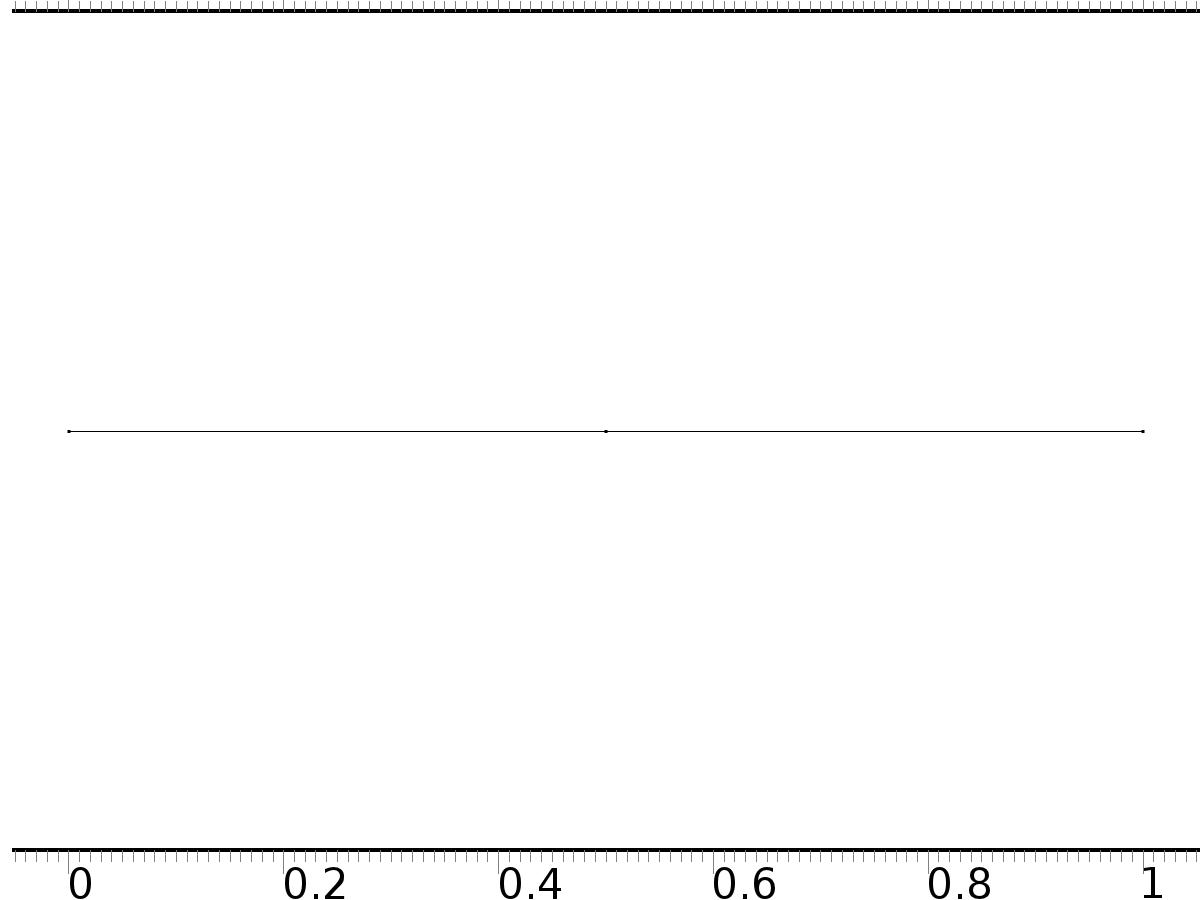
#### Integration 1

|  |  |
| --- | --- |
| Coupling type | Integration |
| Operator name | C |

Source selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | Boundary 2 |

* 1. Geometry 1



Geometry 1

Units

|  |  |
| --- | --- |
| Length unit | m |
| Angular unit | deg |

Geometry statistics

| **Description** | **Value** |
| --- | --- |
| Space dimension | 1 |
| Number of domains | 2 |
| Number of boundaries | 3 |

* + 1. Interval 1 (i1)

Interval

| **Description** | **Value** |
| --- | --- |
| Number of intervals | Many |
| Points | {0, 0.5, 1} |

* 1. Unit input



Unit input

Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Domains 1–2 |

Settings

| **Description** | **Value** |
| --- | --- |
| Shape function type | Lagrange |
| Element order | Quadratic |
| Compute boundary fluxes | On |
| Apply smoothing to boundary fluxes | On |
| Value type when using splitting of complex variables | Complex |
| Dependent variable quantity | Dimensionless (1) |
| Source term quantity | None |
| Unit | m^ - 2 |

Used products

|  |
| --- |
| COMSOL Multiphysics |

Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| X.nx | nx |  | Normal vector, x component | Boundaries 1–3 |
| X.ny | root.ny |  | Normal vector, y component | Boundaries 1–3 |
| X.nz | root.nz |  | Normal vector, z component | Boundaries 1–3 |
| X.nxmesh | root.nxmesh |  | Normal vector (mesh), x component | Boundaries 1–3 |
| X.nymesh | root.nymesh |  | Normal vector (mesh), y component | Boundaries 1–3 |
| X.nzmesh | root.nzmesh |  | Normal vector (mesh), z component | Boundaries 1–3 |

* + 1. Coefficient Form PDE 1



Coefficient Form PDE 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Domains 1–2 |

Equations

Settings

| **Description** | **Value** |
| --- | --- |
| Diffusion coefficient | 1 |
| Absorption coefficient | 0 |
| Source term | 0 |
| Mass coefficient | 0 |
| Damping or mass coefficient | 0 |
| Conservative flux convection coefficient | 0 |
| Convection coefficient | 0 |
| Conservative flux source | 0 |

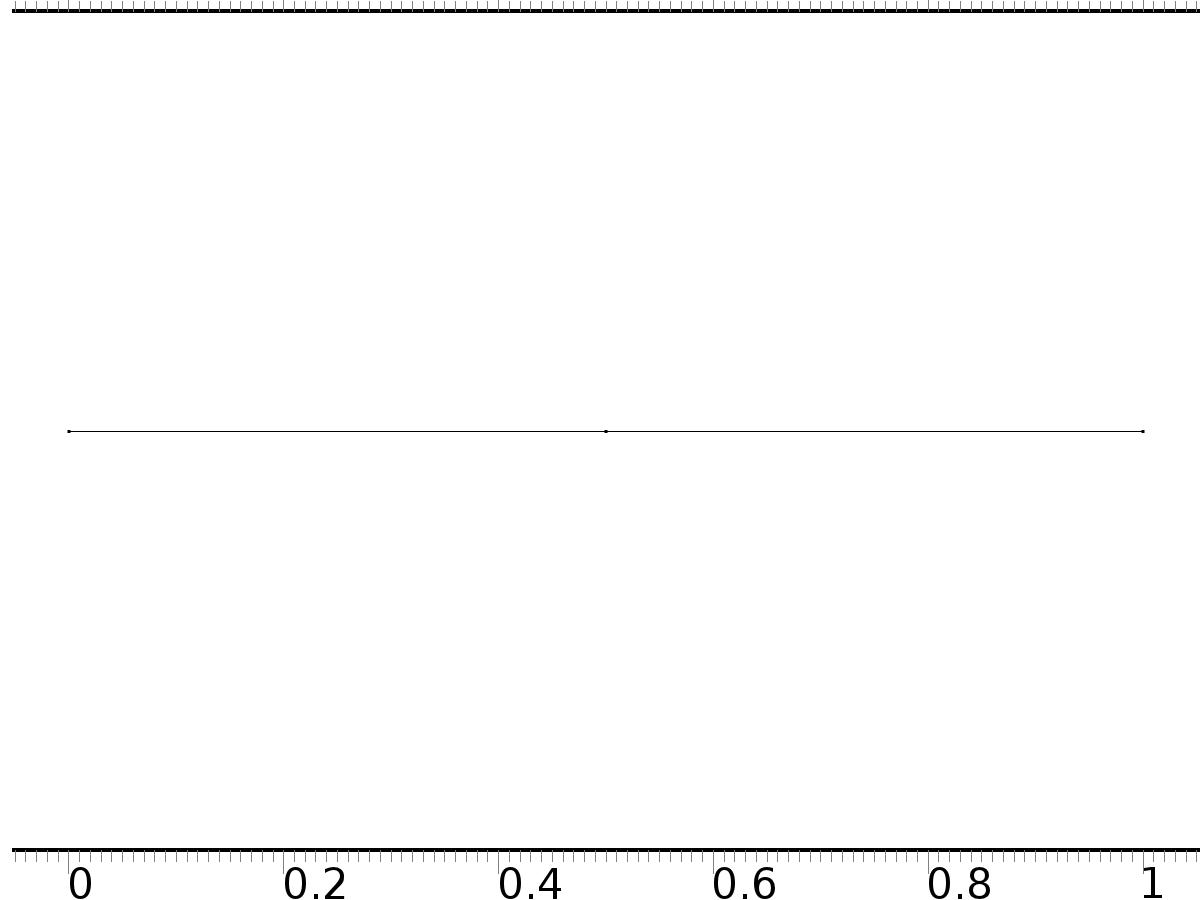
#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| domflux.Xx | -d(X,x) |  | Domain flux, x component | Domains 1–2 |

#### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| X | Lagrange (Quadratic) |  | Dependent variable X | Material | Domains 1–2 |

* + 1. Zero Flux 1



Zero Flux 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | No boundaries |

Equations

* + 1. Initial Values 1



Initial Values 1

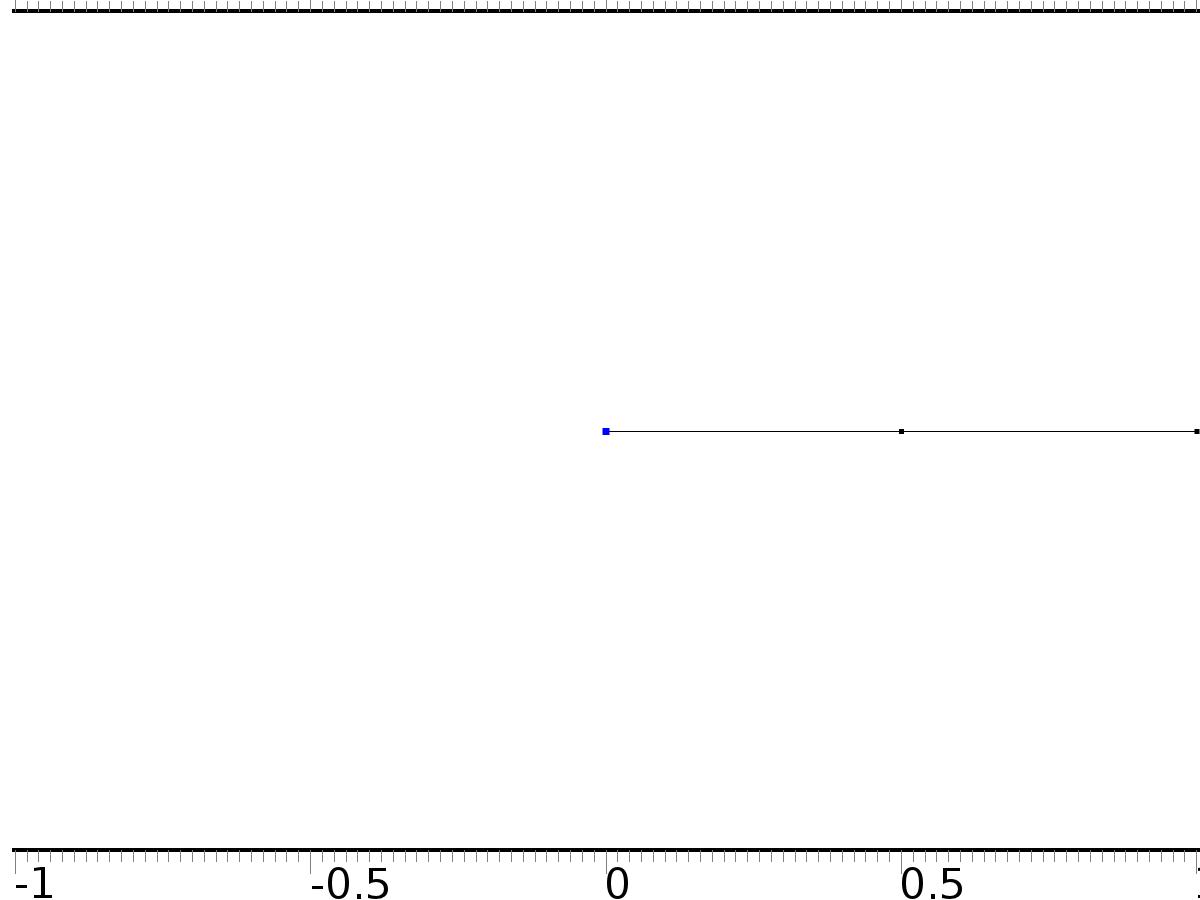
Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Domains 1–2 |

Settings

| **Description** | **Value** |
| --- | --- |
| Initial value for X | 0 |
| Initial time derivative of X | 0 |

* + 1. Bd\*0



Bd\*0

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | Boundary 1 |

Equations

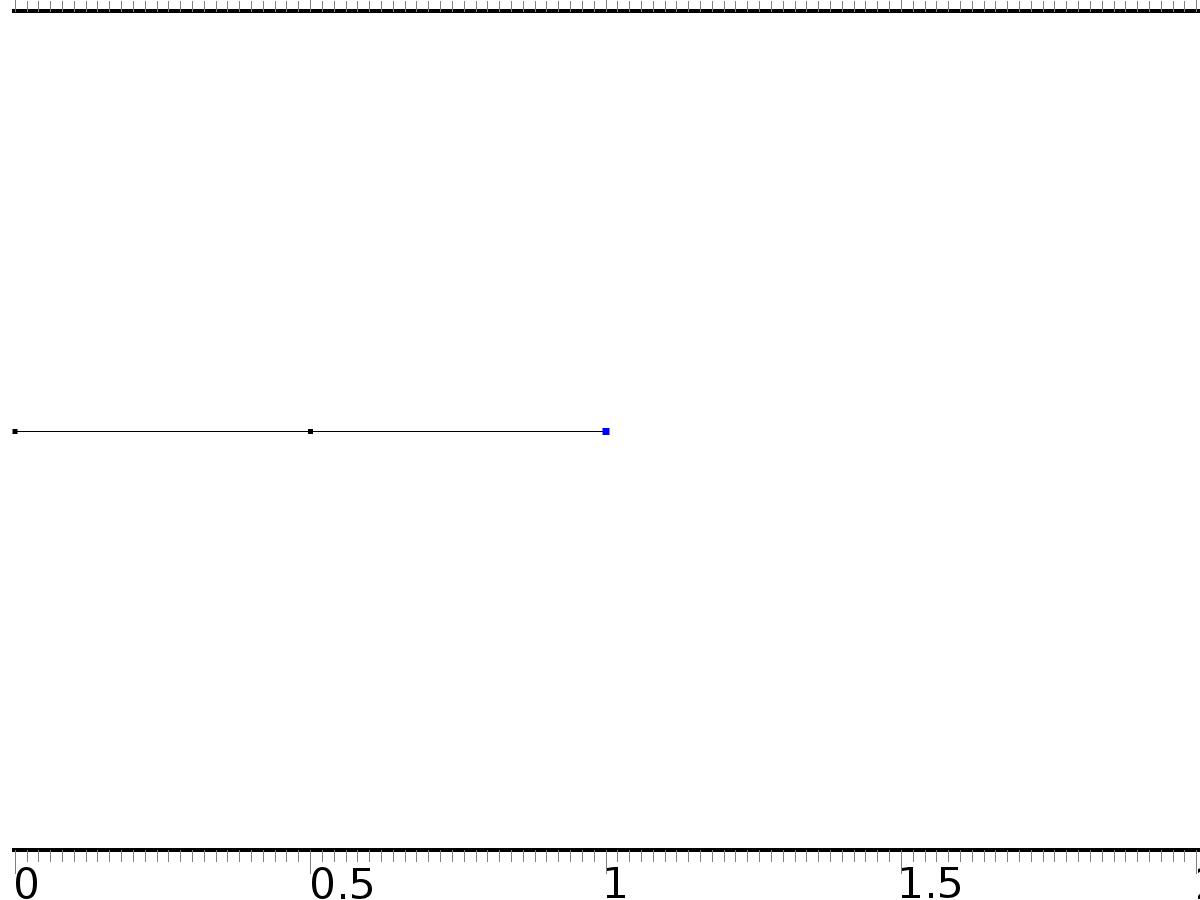
Settings

| **Description** | **Value** |
| --- | --- |
| Value on boundary | 0 |
| Prescribed value of X | On |
| Apply reaction terms on | Individual dependent variables |
| Use weak constraints | Off |
| Constraint method | Elemental |

#### Shape functions

| **Constraint** | **Constraint force** | **Shape function** | **Selection** |
| --- | --- | --- | --- |
| -X | -test(X) | Lagrange (Quadratic) | Boundary 1 |

* + 1. Bin\*1



Bin\*1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | Boundary 3 |

Equations

Settings

| **Description** | **Value** |
| --- | --- |
| Boundary flux/source | 1 |
| Boundary absorption/impedance term | 0 |

#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| X.g\_X | 1 |  | Boundary flux/source | Boundary 3 |

* 1. Regulator Equation PI0



Regulator Equation PI0

Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Domains 1–2 |

Settings

| **Description** | **Value** |
| --- | --- |
| Shape function type | Lagrange |
| Element order | Quadratic |
| Compute boundary fluxes | On |
| Apply smoothing to boundary fluxes | On |
| Value type when using splitting of complex variables | Complex |
| Dependent variable quantity | Dimensionless (1) |
| Source term quantity | None |
| Unit | m^ - 2 |

Used products

|  |
| --- |
| COMSOL Multiphysics |

Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| A0.nx | nx |  | Normal vector, x component | Boundaries 1–3 |
| A0.ny | root.ny |  | Normal vector, y component | Boundaries 1–3 |
| A0.nz | root.nz |  | Normal vector, z component | Boundaries 1–3 |
| A0.nxmesh | root.nxmesh |  | Normal vector (mesh), x component | Boundaries 1–3 |
| A0.nymesh | root.nymesh |  | Normal vector (mesh), y component | Boundaries 1–3 |
| A0.nzmesh | root.nzmesh |  | Normal vector (mesh), z component | Boundaries 1–3 |

* + 1. Coefficient Form PDE 1



Coefficient Form PDE 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Domains 1–2 |

Equations

Settings

| **Description** | **Value** |
| --- | --- |
| Diffusion coefficient | {{1, 0}, {0, 1}} |
| Absorption coefficient | {{0, 0}, {0, 0}} |
| Source term | {f\_a0, f\_a0} |
| Mass coefficient | {{0, 0}, {0, 0}} |
| Damping or mass coefficient | {{0, 0}, {0, 0}} |
| Conservative flux convection coefficient | {{0, 0}, {0, 0}} |
| Convection coefficient | {{0, 0}, {0, 0}} |
| Conservative flux source | {0, 0} |

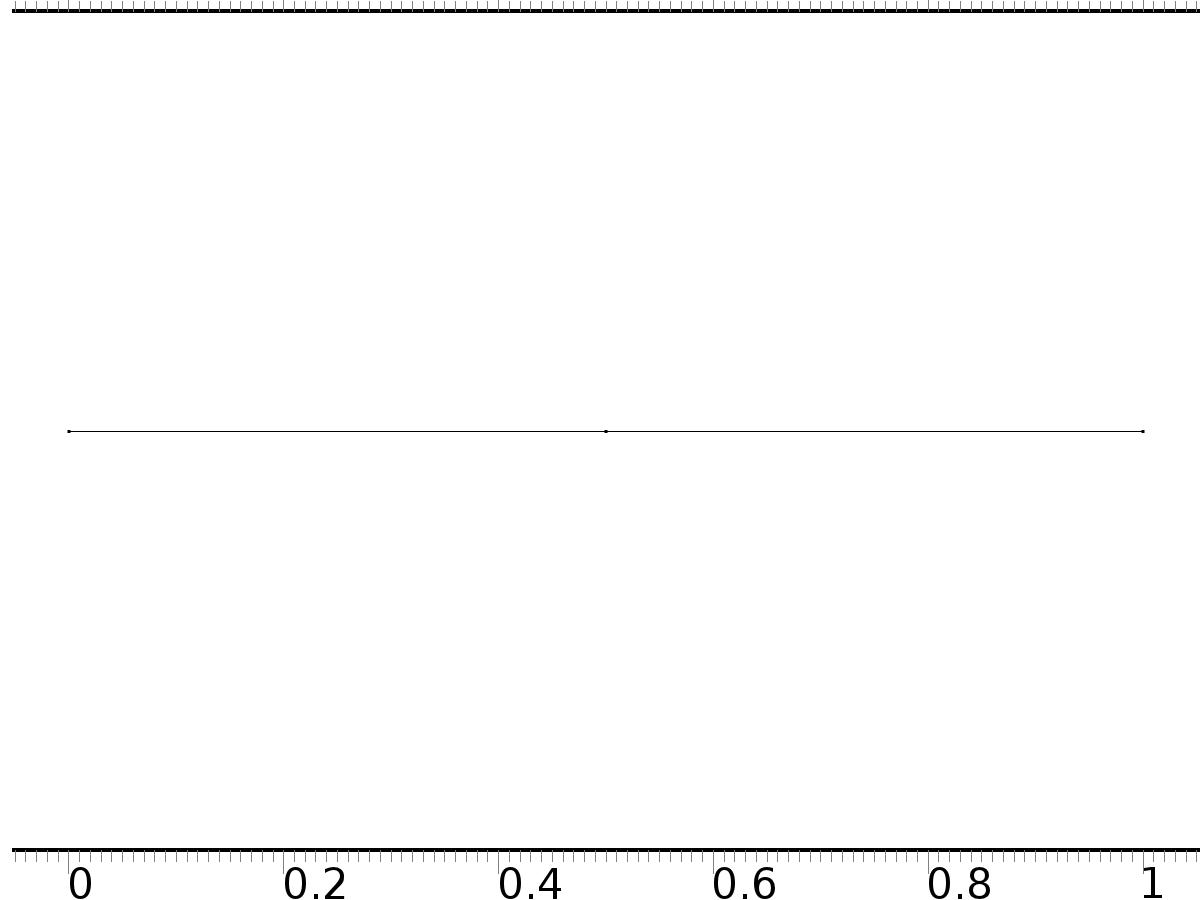
#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| domflux.a0x | -d(a0,x) |  | Domain flux, x component | Domains 1–2 |
| domflux.at0x | -d(at0,x) |  | Domain flux, x component | Domains 1–2 |

#### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| a0 | Lagrange (Quadratic) |  | Dependent variable a0 | Material | Domains 1–2 |
| at0 | Lagrange (Quadratic) |  | Dependent variable at0 | Material | Domains 1–2 |

* + 1. Zero Flux 1



Zero Flux 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | No boundaries |

Equations

* + 1. Initial Values 1



Initial Values 1

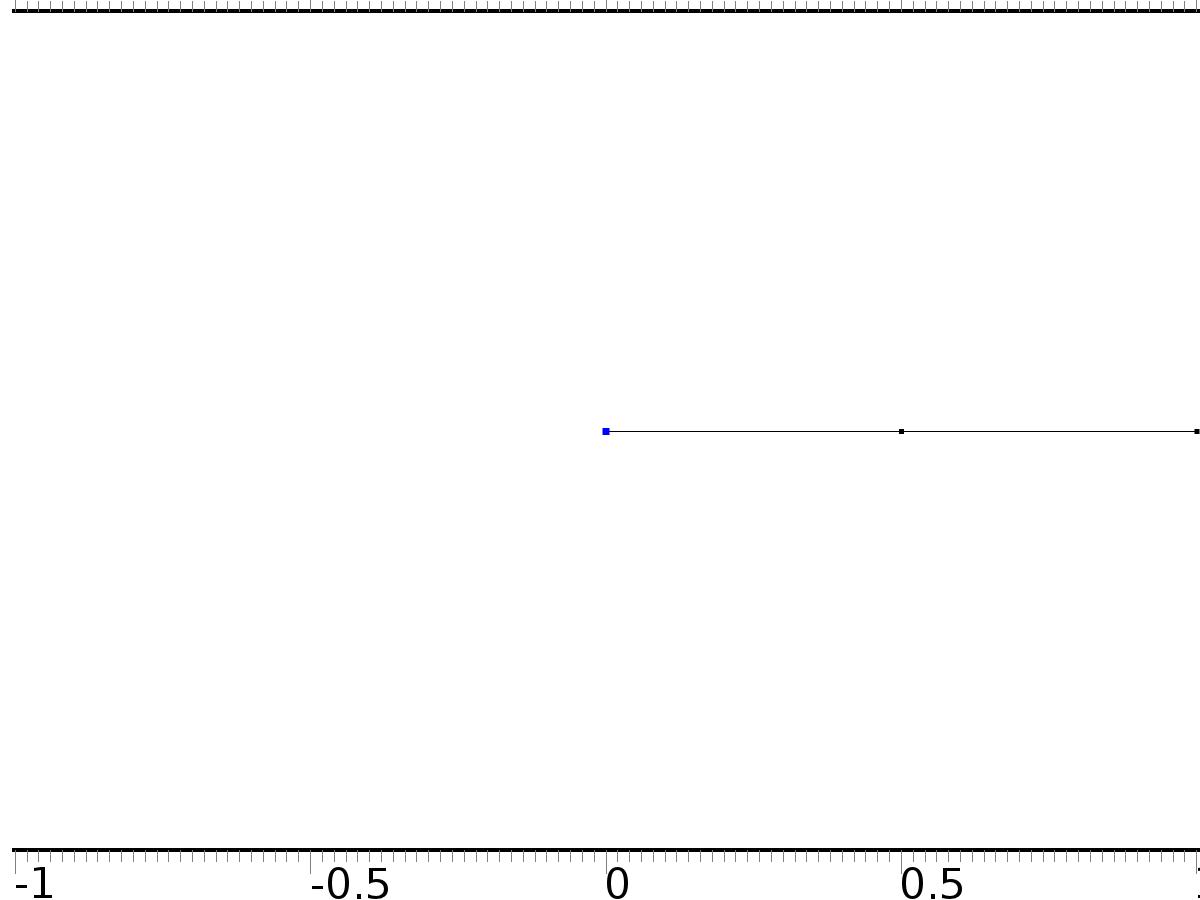
Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Domains 1–2 |

Settings

| **Description** | **Value** |
| --- | --- |
| Initial value for a0 | 0 |
| Initial time derivative of a0 | 0 |
| Initial value for at0 | 0 |
| Initial time derivative of at0 | 0 |

* + 1. Bd\*d0



Bd\*d0

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | Boundary 1 |

Equations

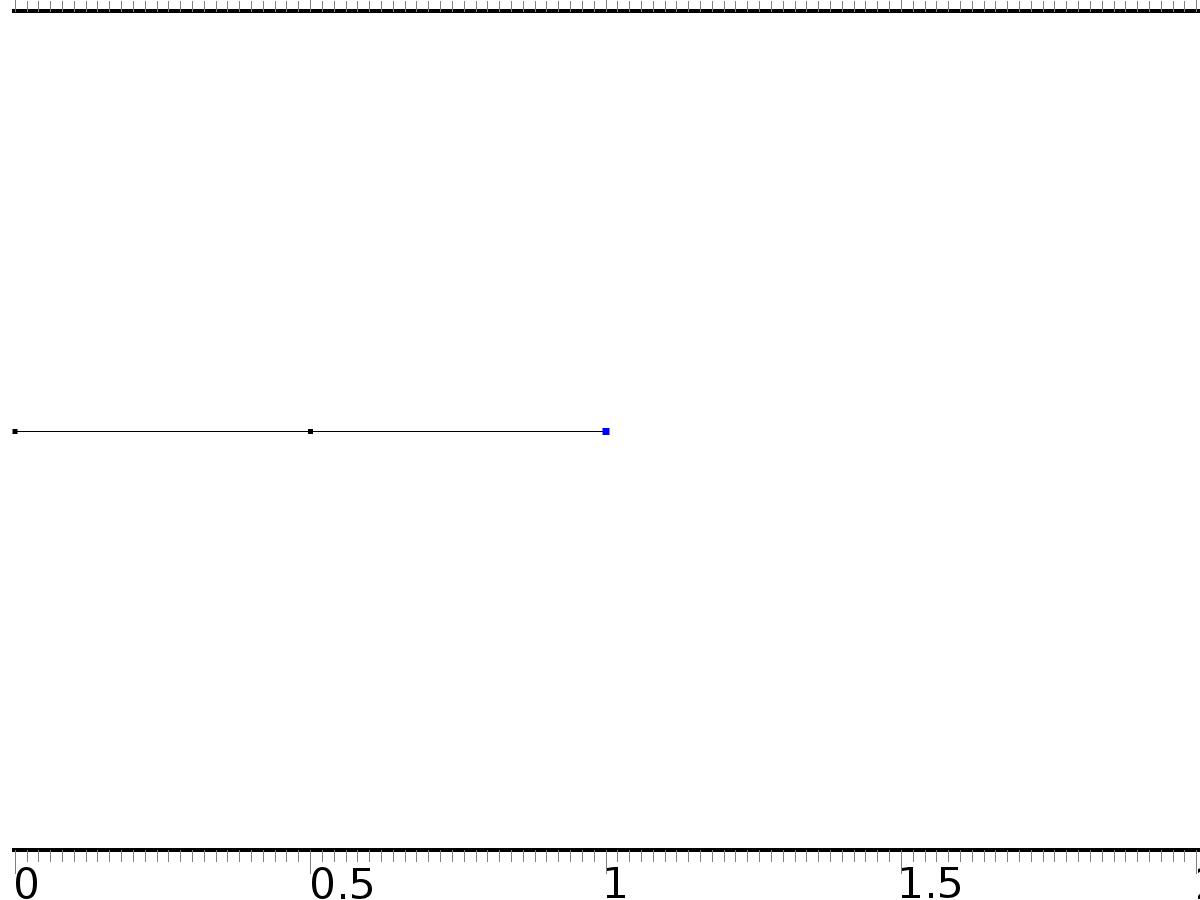
Settings

| **Description** | **Value** |
| --- | --- |
| Value on boundary | {d\_a0, d\_a0} |
| Prescribed value of a0 | On |
| Prescribed value of at0 | On |
| Apply reaction terms on | Individual dependent variables |
| Use weak constraints | Off |
| Constraint method | Elemental |

#### Shape functions

| **Constraint** | **Constraint force** | **Shape function** | **Selection** |
| --- | --- | --- | --- |
| d\_a0-a0 | -test(a0) | Lagrange (Quadratic) | Boundary 1 |
| d\_a0-at0 | -test(at0) | Lagrange (Quadratic) | Boundary 1 |

* + 1. Bin\*Gamma0



Bin\*Gamma0

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | Boundary 3 |

Equations

Settings

| **Description** | **Value** |
| --- | --- |
| Boundary flux/source | {Gamma\_a0, 0} |
| Boundary absorption/impedance term | {{0, 0}, {0, 0}} |

#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| A0.g\_a0 | Gamma\_a0 |  | Boundary flux/source | Boundary 3 |
| A0.g\_at0 | 0 |  | Boundary flux/source | Boundary 3 |

* 1. Regulator Equation PI1



Regulator Equation PI1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Domains 1–2 |

Settings

| **Description** | **Value** |
| --- | --- |
| Shape function type | Lagrange |
| Element order | Quadratic |
| Compute boundary fluxes | On |
| Apply smoothing to boundary fluxes | On |
| Value type when using splitting of complex variables | Complex |
| Dependent variable quantity | Dimensionless (1) |
| Source term quantity | None |
| Unit | m^ - 2 |

Used products

|  |
| --- |
| COMSOL Multiphysics |

Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| A1.nx | nx |  | Normal vector, x component | Boundaries 1–3 |
| A1.ny | root.ny |  | Normal vector, y component | Boundaries 1–3 |
| A1.nz | root.nz |  | Normal vector, z component | Boundaries 1–3 |
| A1.nxmesh | root.nxmesh |  | Normal vector (mesh), x component | Boundaries 1–3 |
| A1.nymesh | root.nymesh |  | Normal vector (mesh), y component | Boundaries 1–3 |
| A1.nzmesh | root.nzmesh |  | Normal vector (mesh), z component | Boundaries 1–3 |

* + 1. Coefficient Form PDE 1



Coefficient Form PDE 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Domains 1–2 |

Equations

Settings

| **Description** | **Value** |
| --- | --- |
| Diffusion coefficient | {{1, 0, 0, 0}, {0, 1, 0, 0}, {0, 0, 1, 0}, {0, 0, 0, 1}} |
| Absorption coefficient | {{0, -alpha, 0, -alpha}, {alpha, 0, alpha, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Source term | {f\_a1, f\_b1, f\_a1, f\_b1} |
| Mass coefficient | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Damping or mass coefficient | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Conservative flux convection coefficient | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Convection coefficient | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Conservative flux source | {0, 0, 0, 0} |

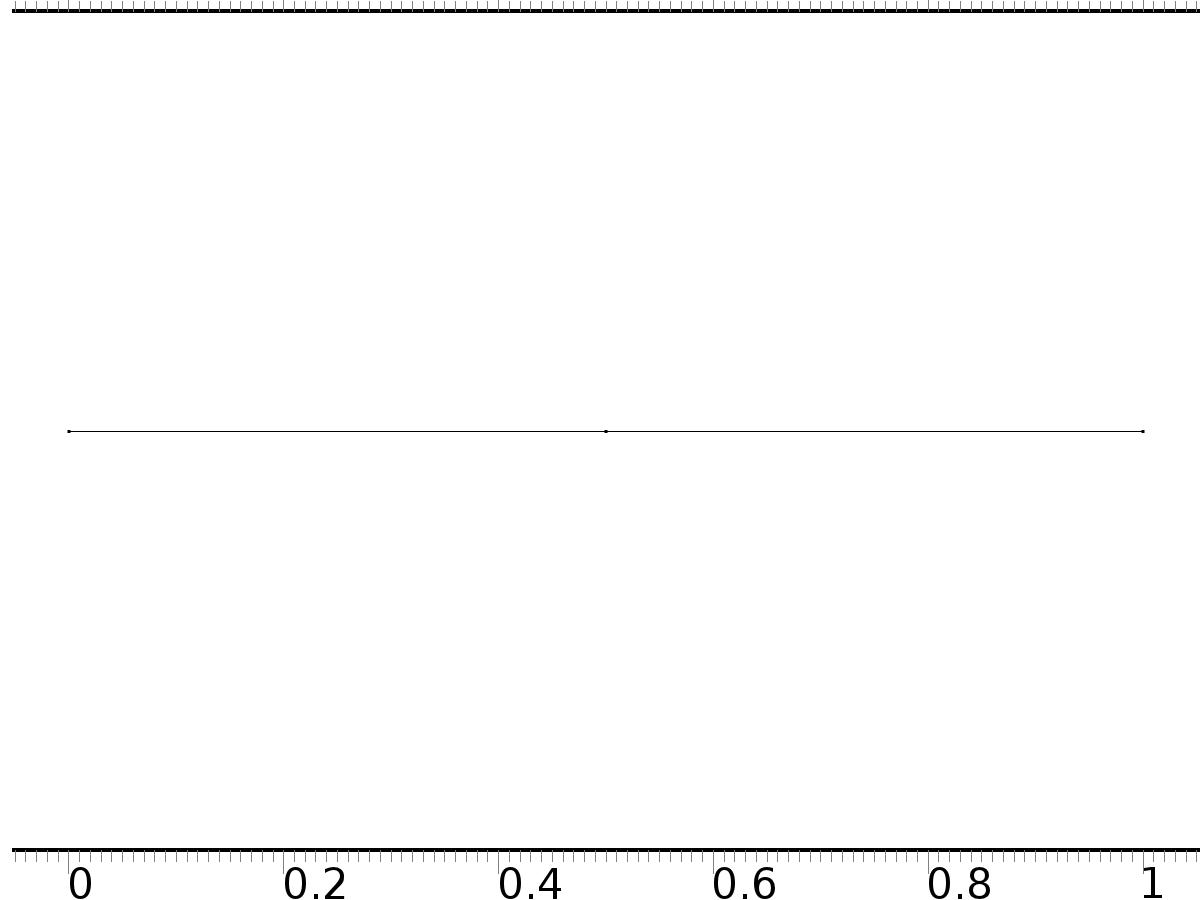
#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| domflux.a1x | -d(a1,x) |  | Domain flux, x component | Domains 1–2 |
| domflux.b1x | -d(b1,x) |  | Domain flux, x component | Domains 1–2 |
| domflux.at1x | -d(at1,x) |  | Domain flux, x component | Domains 1–2 |
| domflux.bt1x | -d(bt1,x) |  | Domain flux, x component | Domains 1–2 |

#### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| a1 | Lagrange (Quadratic) |  | Dependent variable a1 | Material | Domains 1–2 |
| b1 | Lagrange (Quadratic) |  | Dependent variable b1 | Material | Domains 1–2 |
| at1 | Lagrange (Quadratic) |  | Dependent variable at1 | Material | Domains 1–2 |
| bt1 | Lagrange (Quadratic) |  | Dependent variable bt1 | Material | Domains 1–2 |

* + 1. Zero Flux 1



Zero Flux 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | No boundaries |

Equations

* + 1. Initial Values 1



Initial Values 1

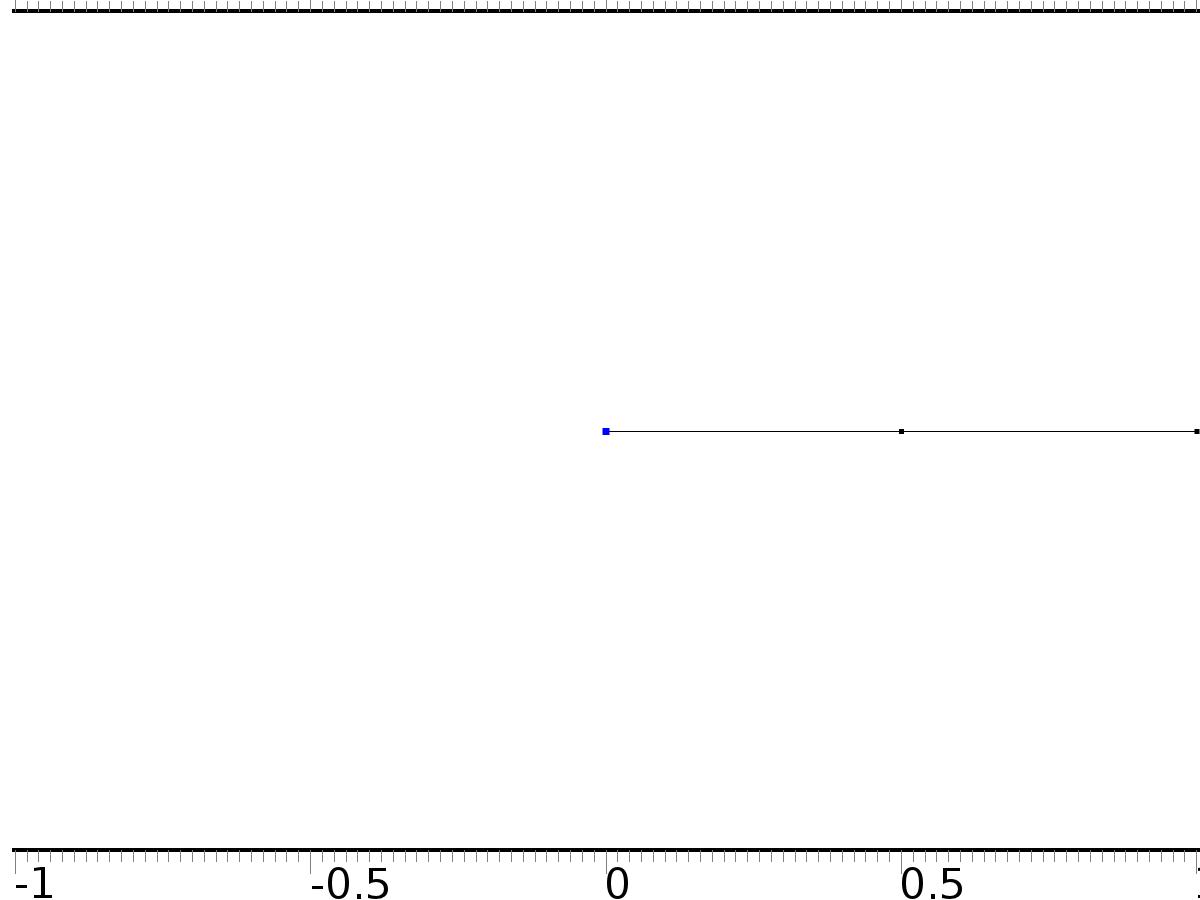
Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Domains 1–2 |

Settings

| **Description** | **Value** |
| --- | --- |
| Initial value for a1 | 0 |
| Initial value for b1 | 0 |
| Initial value for at1 | 0 |
| Initial value for bt1 | 0 |
| Initial time derivative of a1 | 0 |
| Initial time derivative of b1 | 0 |
| Initial time derivative of at1 | 0 |
| Initial time derivative of bt1 | 0 |

* + 1. Bd\*d1



Bd\*d1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | Boundary 1 |

Equations

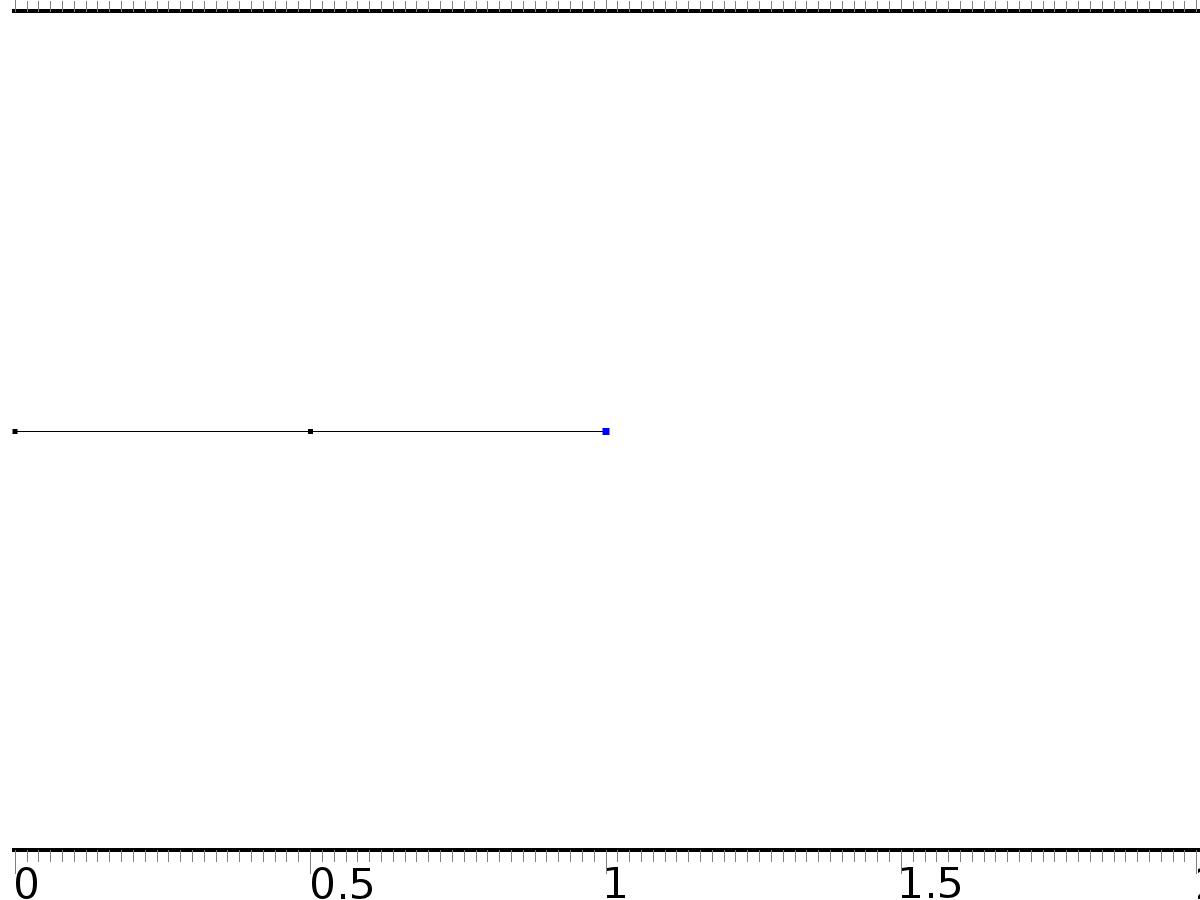
Settings

| **Description** | **Value** |
| --- | --- |
| Value on boundary | {d\_a1, d\_b1, d\_a1, d\_b1} |
| Prescribed value of a1 | On |
| Prescribed value of b1 | On |
| Prescribed value of at1 | On |
| Prescribed value of bt1 | On |
| Apply reaction terms on | Individual dependent variables |
| Use weak constraints | Off |
| Constraint method | Elemental |

#### Shape functions

| **Constraint** | **Constraint force** | **Shape function** | **Selection** |
| --- | --- | --- | --- |
| d\_a1-a1 | -test(a1) | Lagrange (Quadratic) | Boundary 1 |
| d\_b1-b1 | -test(b1) | Lagrange (Quadratic) | Boundary 1 |
| d\_a1-at1 | -test(at1) | Lagrange (Quadratic) | Boundary 1 |
| d\_b1-bt1 | -test(bt1) | Lagrange (Quadratic) | Boundary 1 |

* + 1. Bin\*Gamma1



Bin\*Gamma1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | Boundary 3 |

Equations

Settings

| **Description** | **Value** |
| --- | --- |
| Boundary flux/source | {Gamma\_a1, Gamma\_b1, 0, 0} |
| Boundary absorption/impedance term | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |

#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| A1.g\_a1 | Gamma\_a1 |  | Boundary flux/source | Boundary 3 |
| A1.g\_b1 | Gamma\_b1 |  | Boundary flux/source | Boundary 3 |
| A1.g\_at1 | 0 |  | Boundary flux/source | Boundary 3 |
| A1.g\_bt1 | 0 |  | Boundary flux/source | Boundary 3 |

* 1. Regulator Equation PI2



Regulator Equation PI2

Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Domains 1–2 |

Settings

| **Description** | **Value** |
| --- | --- |
| Shape function type | Lagrange |
| Element order | Quadratic |
| Compute boundary fluxes | On |
| Apply smoothing to boundary fluxes | On |
| Value type when using splitting of complex variables | Complex |
| Dependent variable quantity | Dimensionless (1) |
| Source term quantity | None |
| Unit | m^ - 2 |

Used products

|  |
| --- |
| COMSOL Multiphysics |

Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| A2.nx | nx |  | Normal vector, x component | Boundaries 1–3 |
| A2.ny | root.ny |  | Normal vector, y component | Boundaries 1–3 |
| A2.nz | root.nz |  | Normal vector, z component | Boundaries 1–3 |
| A2.nxmesh | root.nxmesh |  | Normal vector (mesh), x component | Boundaries 1–3 |
| A2.nymesh | root.nymesh |  | Normal vector (mesh), y component | Boundaries 1–3 |
| A2.nzmesh | root.nzmesh |  | Normal vector (mesh), z component | Boundaries 1–3 |

* + 1. Coefficient Form PDE 1



Coefficient Form PDE 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Domains 1–2 |

Equations

Settings

| **Description** | **Value** |
| --- | --- |
| Diffusion coefficient | {{1, 0, 0, 0}, {0, 1, 0, 0}, {0, 0, 1, 0}, {0, 0, 0, 1}} |
| Absorption coefficient | {{0, -2\*alpha, 0, -2\*alpha}, {2\*alpha, 0, 2\*alpha, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Source term | {f\_a2, f\_b2, f\_a2, f\_b2} |
| Mass coefficient | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Damping or mass coefficient | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Conservative flux convection coefficient | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Convection coefficient | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Conservative flux source | {0, 0, 0, 0} |

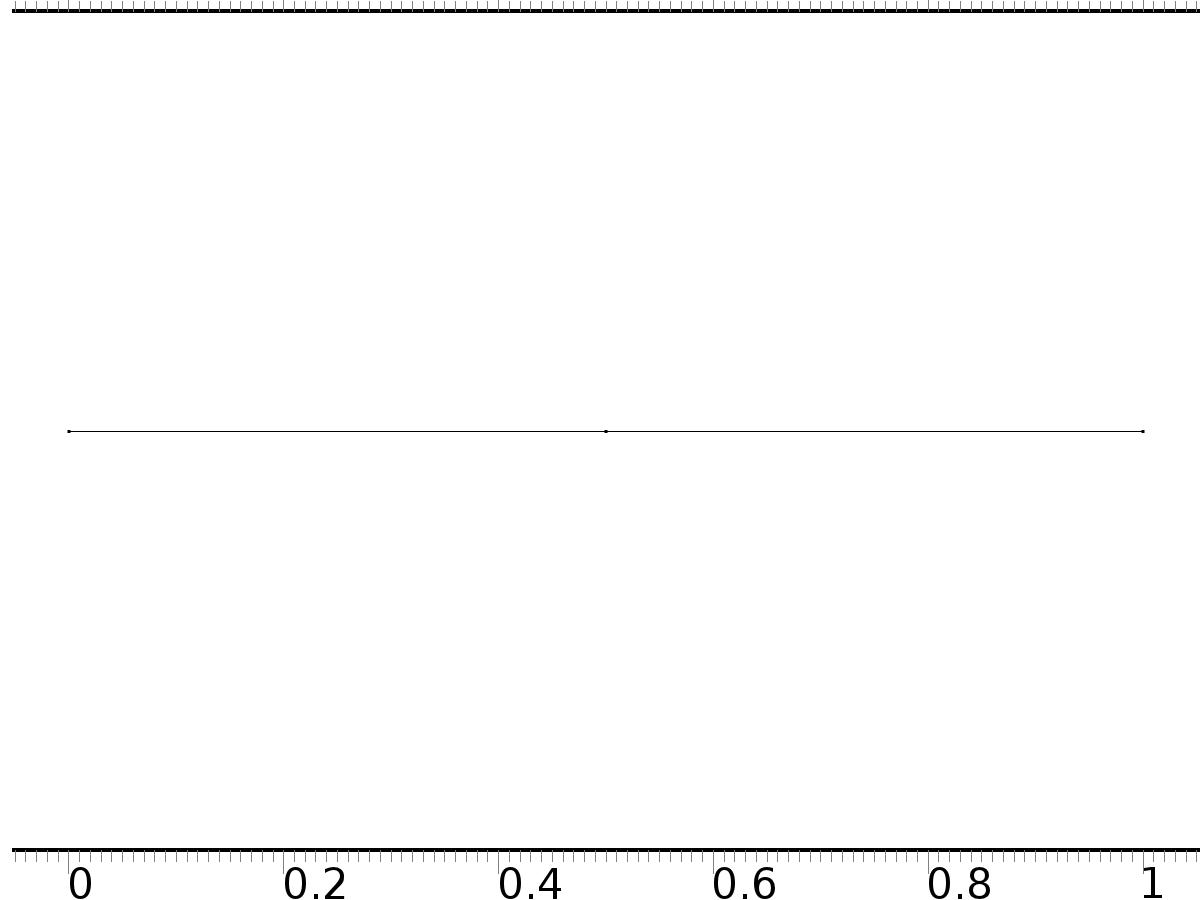
#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| domflux.a2x | -d(a2,x) |  | Domain flux, x component | Domains 1–2 |
| domflux.b2x | -d(b2,x) |  | Domain flux, x component | Domains 1–2 |
| domflux.at2x | -d(at2,x) |  | Domain flux, x component | Domains 1–2 |
| domflux.bt2x | -d(bt2,x) |  | Domain flux, x component | Domains 1–2 |

#### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| a2 | Lagrange (Quadratic) |  | Dependent variable a2 | Material | Domains 1–2 |
| b2 | Lagrange (Quadratic) |  | Dependent variable b2 | Material | Domains 1–2 |
| at2 | Lagrange (Quadratic) |  | Dependent variable at2 | Material | Domains 1–2 |
| bt2 | Lagrange (Quadratic) |  | Dependent variable bt2 | Material | Domains 1–2 |

* + 1. Zero Flux 1



Zero Flux 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | No boundaries |

Equations

* + 1. Initial Values 1



Initial Values 1

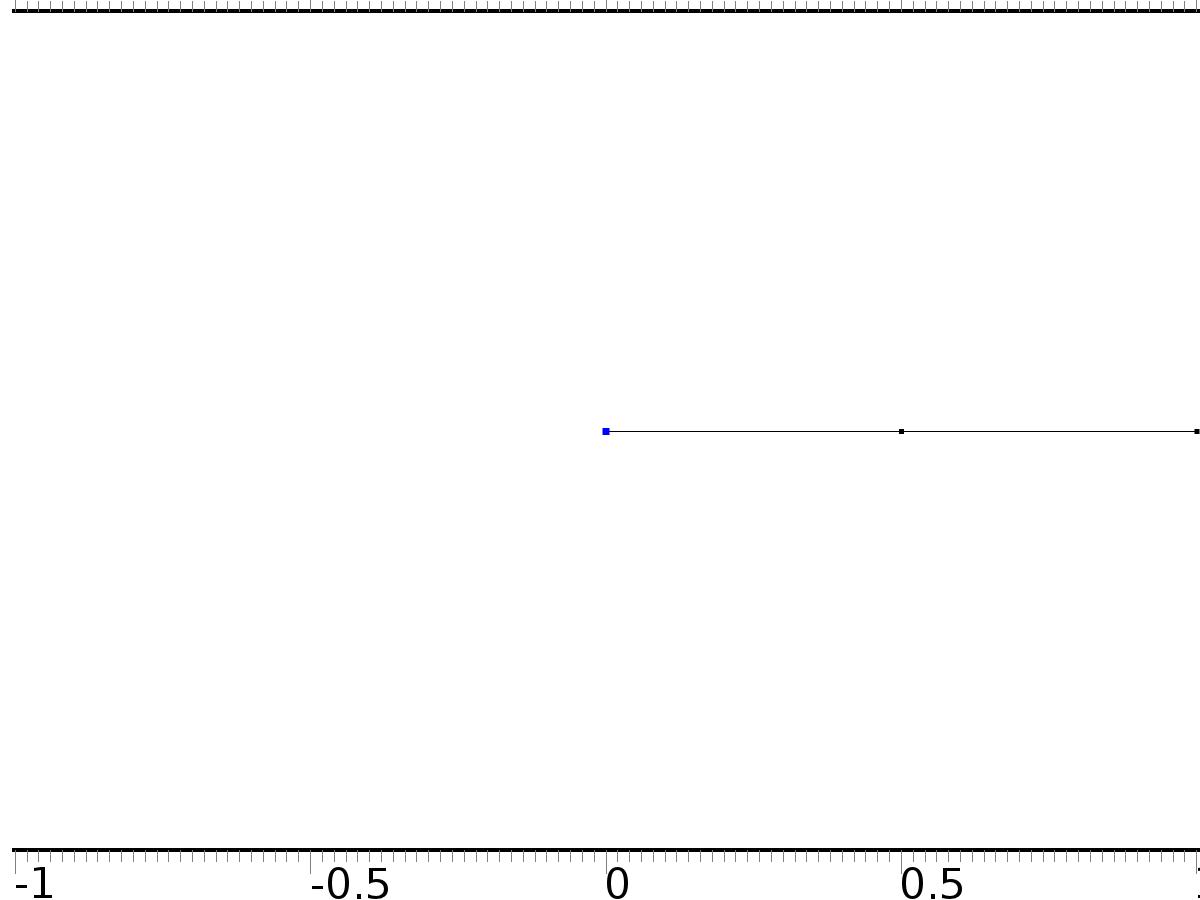
Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Domains 1–2 |

Settings

| **Description** | **Value** |
| --- | --- |
| Initial value for a2 | 0 |
| Initial value for b2 | 0 |
| Initial value for at2 | 0 |
| Initial value for bt2 | 0 |
| Initial time derivative of a2 | 0 |
| Initial time derivative of b2 | 0 |
| Initial time derivative of at2 | 0 |
| Initial time derivative of bt2 | 0 |

* + 1. Bd\*d2



Bd\*d2

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | Boundary 1 |

Equations

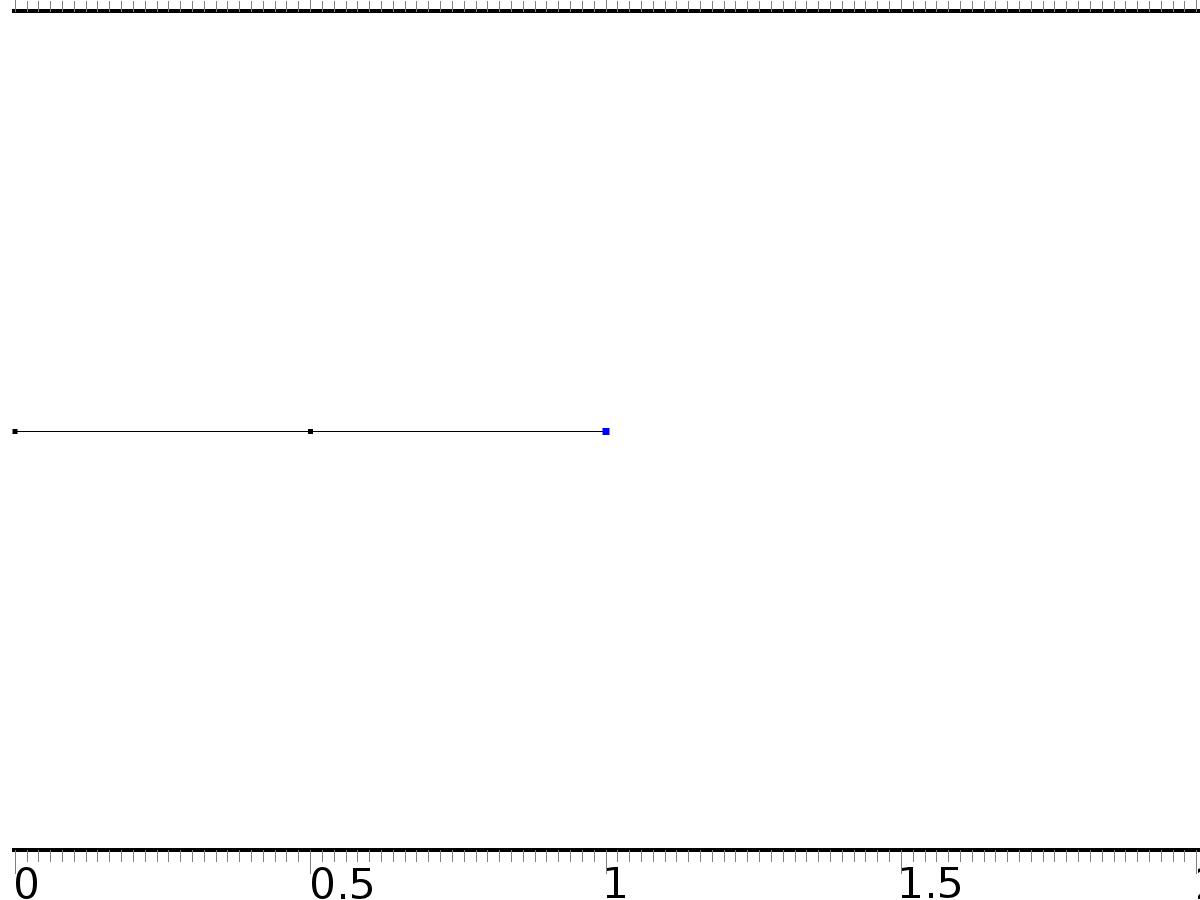
Settings

| **Description** | **Value** |
| --- | --- |
| Value on boundary | {d\_a2, d\_b2, d\_a2, d\_b2} |
| Prescribed value of a2 | On |
| Prescribed value of b2 | On |
| Prescribed value of at2 | On |
| Prescribed value of bt2 | On |
| Apply reaction terms on | Individual dependent variables |
| Use weak constraints | Off |
| Constraint method | Elemental |

#### Shape functions

| **Constraint** | **Constraint force** | **Shape function** | **Selection** |
| --- | --- | --- | --- |
| d\_a2-a2 | -test(a2) | Lagrange (Quadratic) | Boundary 1 |
| d\_b2-b2 | -test(b2) | Lagrange (Quadratic) | Boundary 1 |
| d\_a2-at2 | -test(at2) | Lagrange (Quadratic) | Boundary 1 |
| d\_b2-bt2 | -test(bt2) | Lagrange (Quadratic) | Boundary 1 |

* + 1. Bin\*Gamma2



Bin\*Gamma2

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | Boundary 3 |

Equations

Settings

| **Description** | **Value** |
| --- | --- |
| Boundary flux/source | {Gamma\_a2, Gamma\_b2, 0, 0} |
| Boundary absorption/impedance term | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |

#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| A2.g\_a2 | Gamma\_a2 |  | Boundary flux/source | Boundary 3 |
| A2.g\_b2 | Gamma\_b2 |  | Boundary flux/source | Boundary 3 |
| A2.g\_at2 | 0 |  | Boundary flux/source | Boundary 3 |
| A2.g\_bt2 | 0 |  | Boundary flux/source | Boundary 3 |

* 1. Regulator Equation PI3



Regulator Equation PI3

Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Domains 1–2 |

Settings

| **Description** | **Value** |
| --- | --- |
| Shape function type | Lagrange |
| Element order | Quadratic |
| Compute boundary fluxes | On |
| Apply smoothing to boundary fluxes | On |
| Value type when using splitting of complex variables | Complex |
| Dependent variable quantity | Dimensionless (1) |
| Source term quantity | None |
| Unit | m^ - 2 |

Used products

|  |
| --- |
| COMSOL Multiphysics |

Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| A3.nx | nx |  | Normal vector, x component | Boundaries 1–3 |
| A3.ny | root.ny |  | Normal vector, y component | Boundaries 1–3 |
| A3.nz | root.nz |  | Normal vector, z component | Boundaries 1–3 |
| A3.nxmesh | root.nxmesh |  | Normal vector (mesh), x component | Boundaries 1–3 |
| A3.nymesh | root.nymesh |  | Normal vector (mesh), y component | Boundaries 1–3 |
| A3.nzmesh | root.nzmesh |  | Normal vector (mesh), z component | Boundaries 1–3 |

* + 1. Coefficient Form PDE 1



Coefficient Form PDE 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Domains 1–2 |

Equations

Settings

| **Description** | **Value** |
| --- | --- |
| Diffusion coefficient | {{1, 0, 0, 0}, {0, 1, 0, 0}, {0, 0, 1, 0}, {0, 0, 0, 1}} |
| Absorption coefficient | {{0, -3\*alpha, 0, -3\*alpha}, {3\*alpha, 0, 3\*alpha, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Source term | {f\_a3, f\_b3, f\_a3, f\_b3} |
| Mass coefficient | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Damping or mass coefficient | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Conservative flux convection coefficient | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Convection coefficient | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Conservative flux source | {0, 0, 0, 0} |

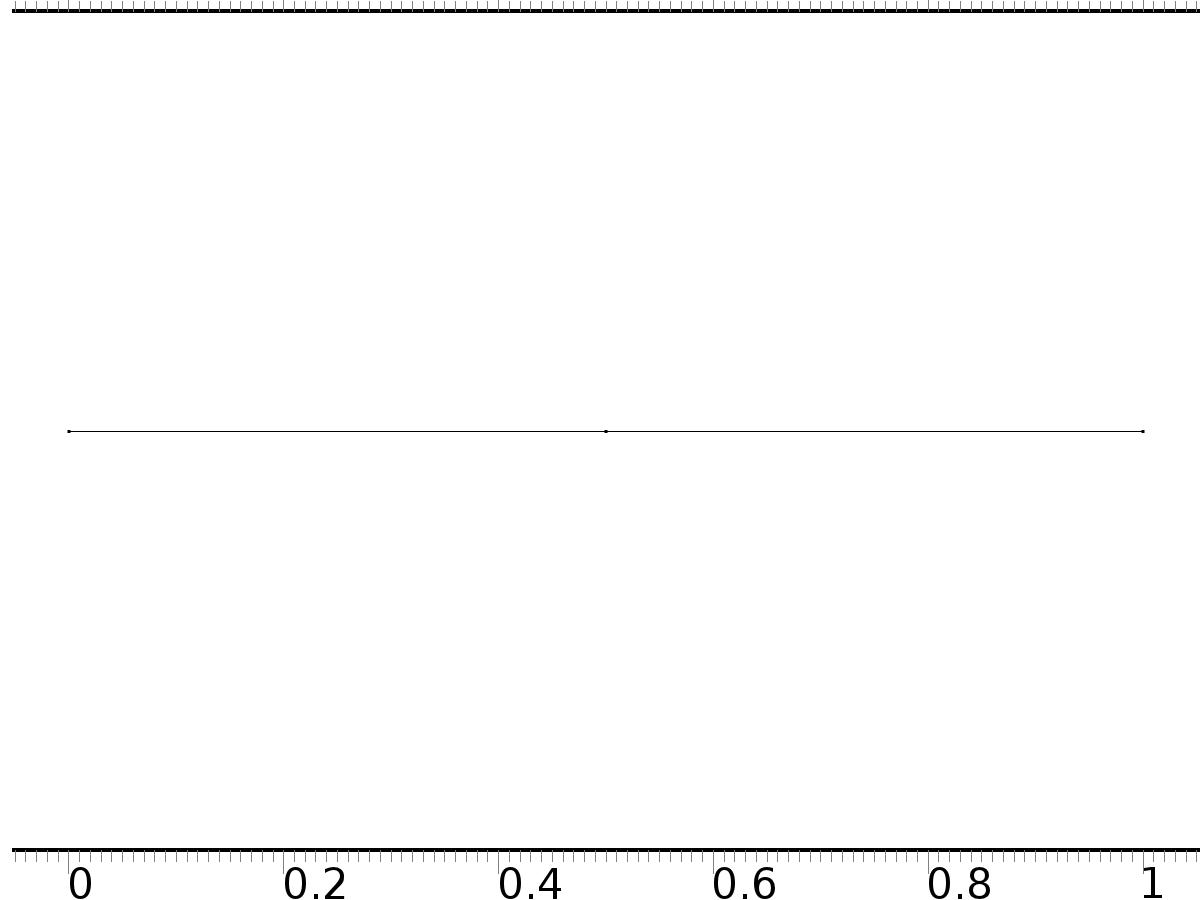
#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| domflux.a3x | -d(a3,x) |  | Domain flux, x component | Domains 1–2 |
| domflux.b3x | -d(b3,x) |  | Domain flux, x component | Domains 1–2 |
| domflux.at3x | -d(at3,x) |  | Domain flux, x component | Domains 1–2 |
| domflux.bt3x | -d(bt3,x) |  | Domain flux, x component | Domains 1–2 |

#### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| a3 | Lagrange (Quadratic) |  | Dependent variable a3 | Material | Domains 1–2 |
| b3 | Lagrange (Quadratic) |  | Dependent variable b3 | Material | Domains 1–2 |
| at3 | Lagrange (Quadratic) |  | Dependent variable at3 | Material | Domains 1–2 |
| bt3 | Lagrange (Quadratic) |  | Dependent variable bt3 | Material | Domains 1–2 |

* + 1. Zero Flux 1



Zero Flux 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | No boundaries |

Equations

* + 1. Initial Values 1



Initial Values 1

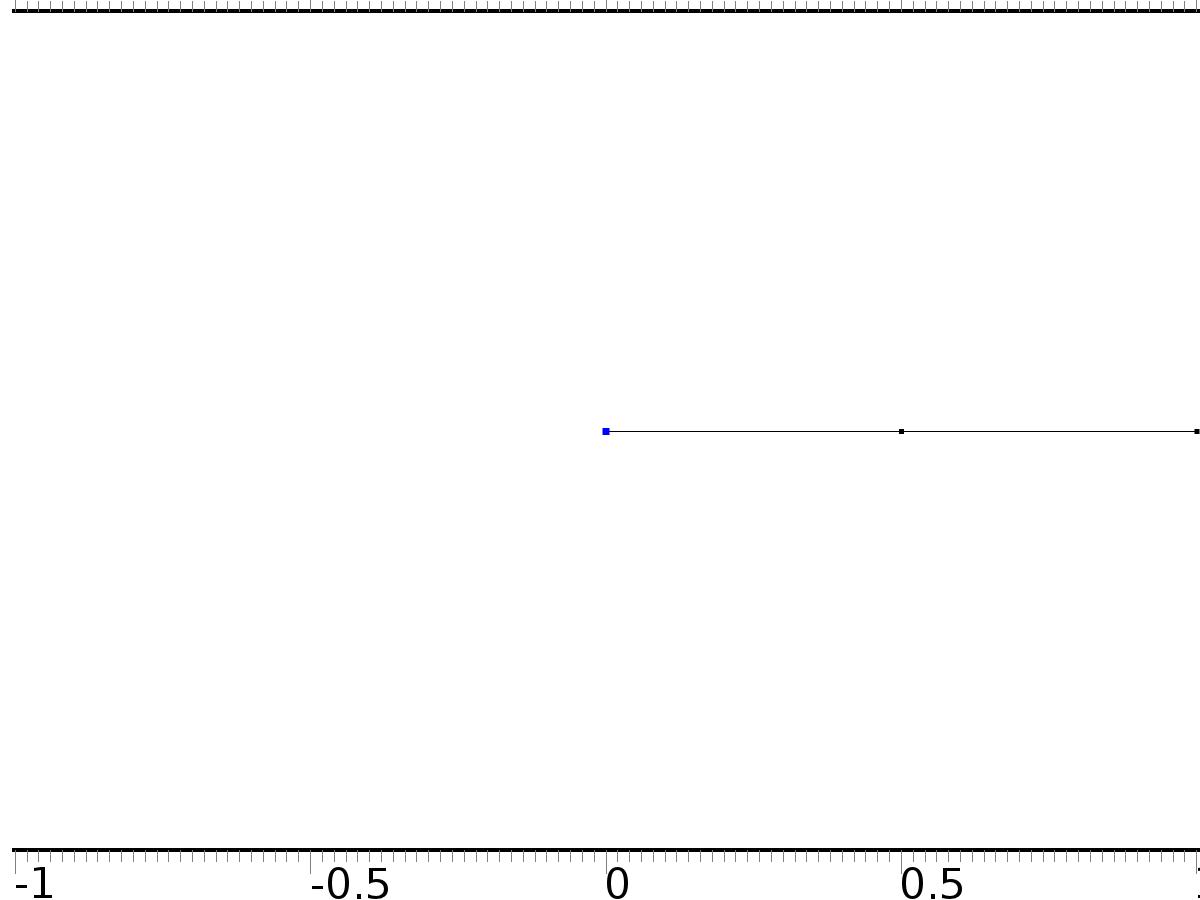
Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Domains 1–2 |

Settings

| **Description** | **Value** |
| --- | --- |
| Initial value for a3 | 0 |
| Initial value for b3 | 0 |
| Initial value for at3 | 0 |
| Initial value for bt3 | 0 |
| Initial time derivative of a3 | 0 |
| Initial time derivative of b3 | 0 |
| Initial time derivative of at3 | 0 |
| Initial time derivative of bt3 | 0 |

* + 1. Bd\*d3



Bd\*d3

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | Boundary 1 |

Equations

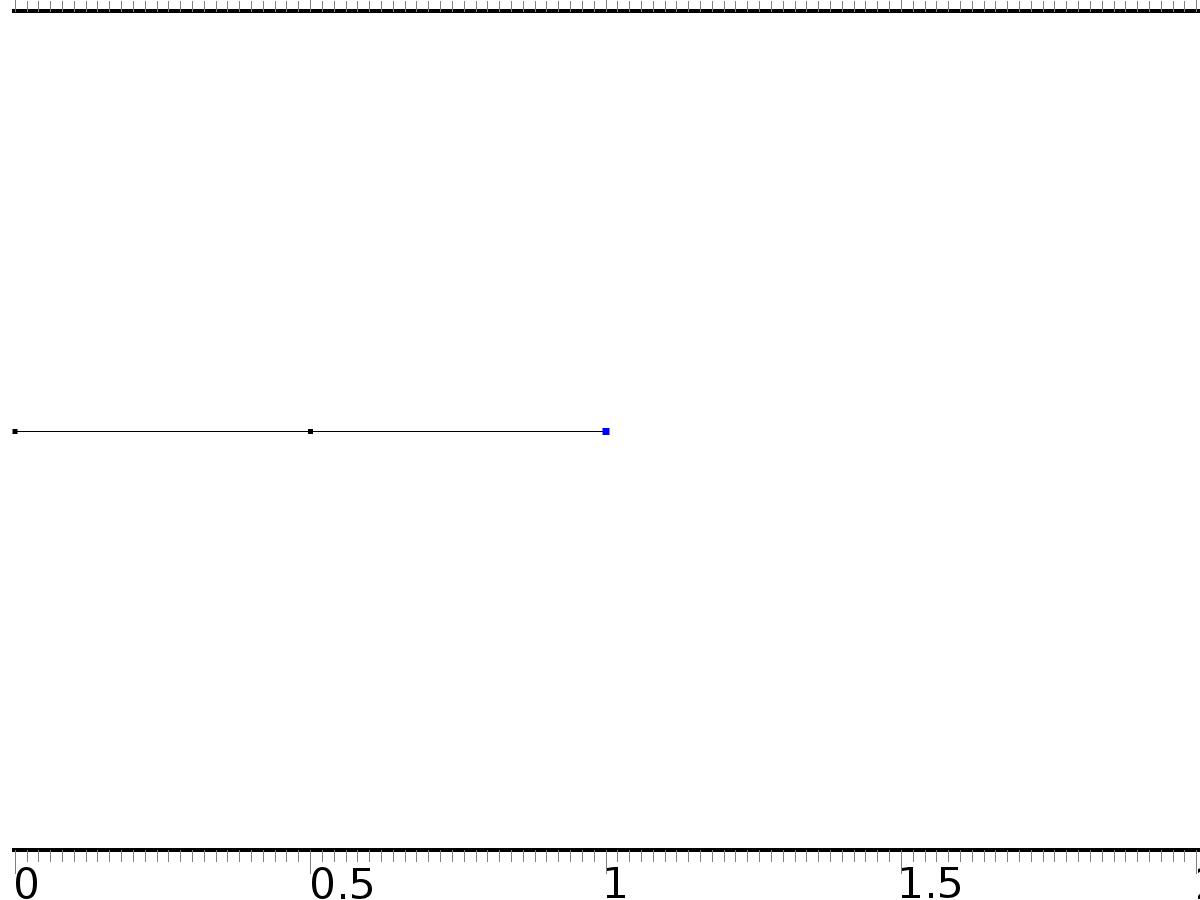
Settings

| **Description** | **Value** |
| --- | --- |
| Value on boundary | {d\_a3, d\_b3, d\_a3, d\_b3} |
| Prescribed value of a3 | On |
| Prescribed value of b3 | On |
| Prescribed value of at3 | On |
| Prescribed value of bt3 | On |
| Apply reaction terms on | Individual dependent variables |
| Use weak constraints | Off |
| Constraint method | Elemental |

#### Shape functions

| **Constraint** | **Constraint force** | **Shape function** | **Selection** |
| --- | --- | --- | --- |
| d\_a3-a3 | -test(a3) | Lagrange (Quadratic) | Boundary 1 |
| d\_b3-b3 | -test(b3) | Lagrange (Quadratic) | Boundary 1 |
| d\_a3-at3 | -test(at3) | Lagrange (Quadratic) | Boundary 1 |
| d\_b3-bt3 | -test(bt3) | Lagrange (Quadratic) | Boundary 1 |

* + 1. Bin\*Gamma3



Bin\*Gamma3

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | Boundary 3 |

Equations

Settings

| **Description** | **Value** |
| --- | --- |
| Boundary flux/source | {Gamma\_a3, Gamma\_b3, 0, 0} |
| Boundary absorption/impedance term | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |

#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| A3.g\_a3 | Gamma\_a3 |  | Boundary flux/source | Boundary 3 |
| A3.g\_b3 | Gamma\_b3 |  | Boundary flux/source | Boundary 3 |
| A3.g\_at3 | 0 |  | Boundary flux/source | Boundary 3 |
| A3.g\_bt3 | 0 |  | Boundary flux/source | Boundary 3 |

* 1. Regulator Equation PI4



Regulator Equation PI4

Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Domains 1–2 |

Settings

| **Description** | **Value** |
| --- | --- |
| Shape function type | Lagrange |
| Element order | Quadratic |
| Compute boundary fluxes | On |
| Apply smoothing to boundary fluxes | On |
| Value type when using splitting of complex variables | Complex |
| Dependent variable quantity | Dimensionless (1) |
| Source term quantity | None |
| Unit | m^ - 2 |

Used products

|  |
| --- |
| COMSOL Multiphysics |

Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| A4.nx | nx |  | Normal vector, x component | Boundaries 1–3 |
| A4.ny | root.ny |  | Normal vector, y component | Boundaries 1–3 |
| A4.nz | root.nz |  | Normal vector, z component | Boundaries 1–3 |
| A4.nxmesh | root.nxmesh |  | Normal vector (mesh), x component | Boundaries 1–3 |
| A4.nymesh | root.nymesh |  | Normal vector (mesh), y component | Boundaries 1–3 |
| A4.nzmesh | root.nzmesh |  | Normal vector (mesh), z component | Boundaries 1–3 |

* + 1. Coefficient Form PDE 1



Coefficient Form PDE 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Domains 1–2 |

Equations

Settings

| **Description** | **Value** |
| --- | --- |
| Diffusion coefficient | {{1, 0, 0, 0}, {0, 1, 0, 0}, {0, 0, 1, 0}, {0, 0, 0, 1}} |
| Absorption coefficient | {{0, -4\*alpha, 0, -4\*alpha}, {4\*alpha, 0, 4\*alpha, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Source term | {f\_a4, f\_b4, f\_a4, f\_b4} |
| Mass coefficient | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Damping or mass coefficient | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Conservative flux convection coefficient | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Convection coefficient | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Conservative flux source | {0, 0, 0, 0} |

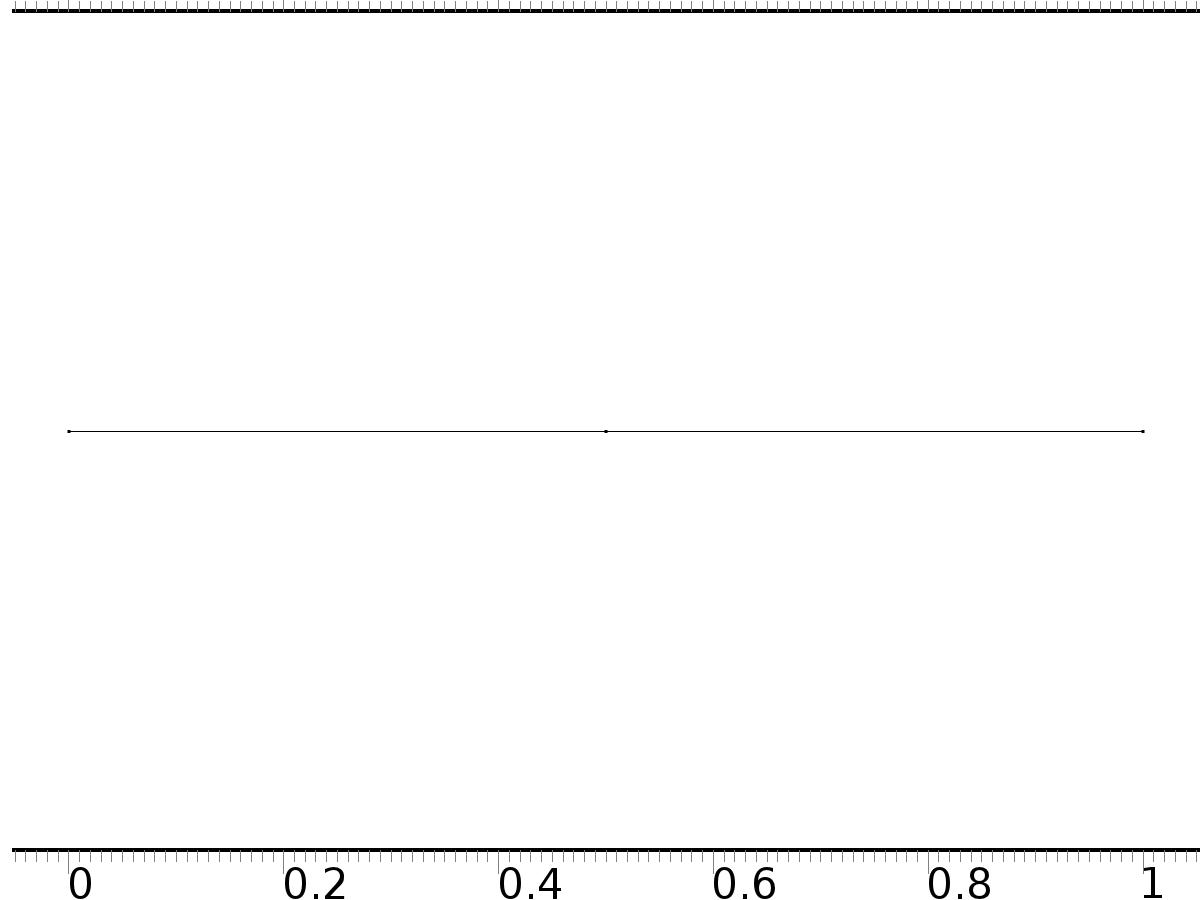
#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| domflux.a4x | -d(a4,x) |  | Domain flux, x component | Domains 1–2 |
| domflux.b4x | -d(b4,x) |  | Domain flux, x component | Domains 1–2 |
| domflux.at4x | -d(at4,x) |  | Domain flux, x component | Domains 1–2 |
| domflux.bt4x | -d(bt4,x) |  | Domain flux, x component | Domains 1–2 |

#### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| a4 | Lagrange (Quadratic) |  | Dependent variable a4 | Material | Domains 1–2 |
| b4 | Lagrange (Quadratic) |  | Dependent variable b4 | Material | Domains 1–2 |
| at4 | Lagrange (Quadratic) |  | Dependent variable at4 | Material | Domains 1–2 |
| bt4 | Lagrange (Quadratic) |  | Dependent variable bt4 | Material | Domains 1–2 |

* + 1. Zero Flux 1



Zero Flux 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | No boundaries |

Equations

* + 1. Initial Values 1



Initial Values 1

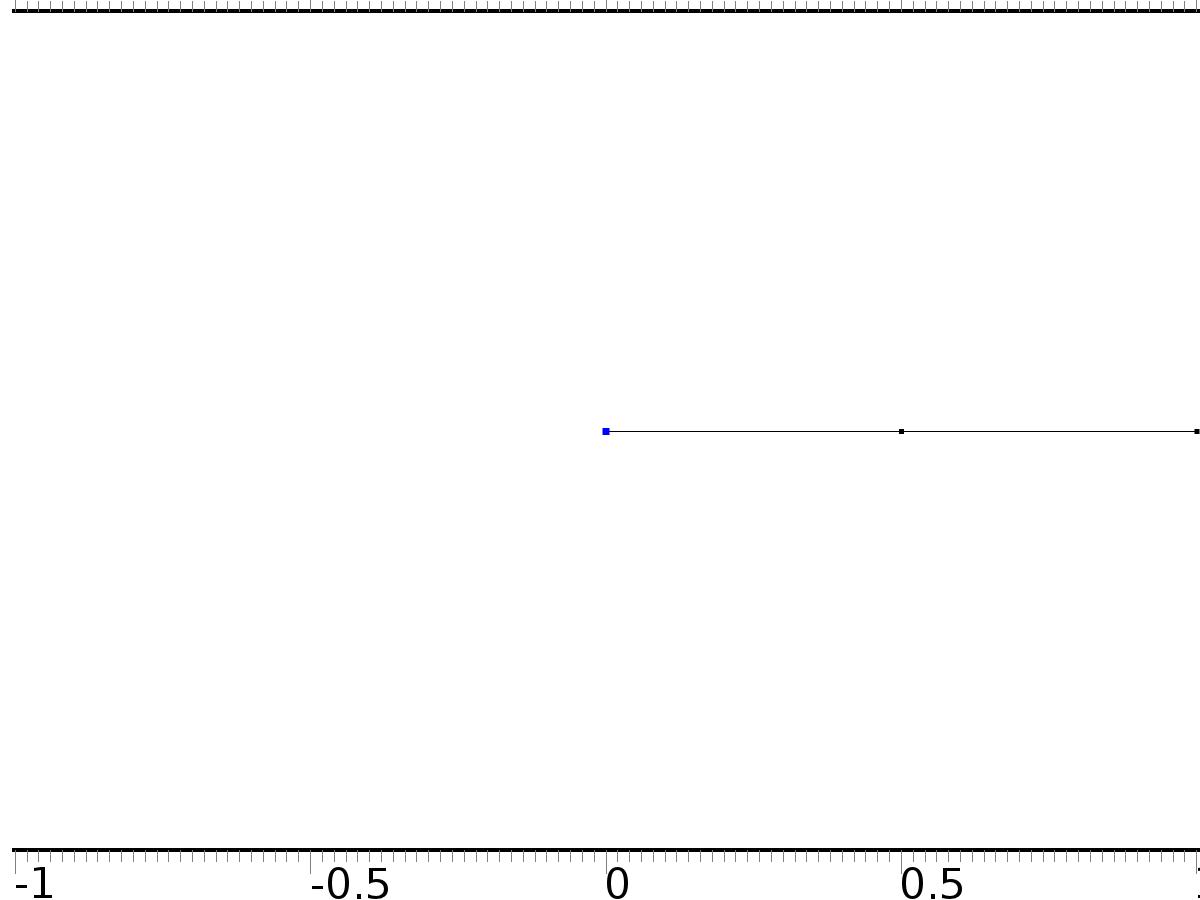
Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Domains 1–2 |

Settings

| **Description** | **Value** |
| --- | --- |
| Initial value for a4 | 0 |
| Initial value for b4 | 0 |
| Initial value for at4 | 0 |
| Initial value for bt4 | 0 |
| Initial time derivative of a4 | 0 |
| Initial time derivative of b4 | 0 |
| Initial time derivative of at4 | 0 |
| Initial time derivative of bt4 | 0 |

* + 1. Bd\*d4



Bd\*d4

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | Boundary 1 |

Equations

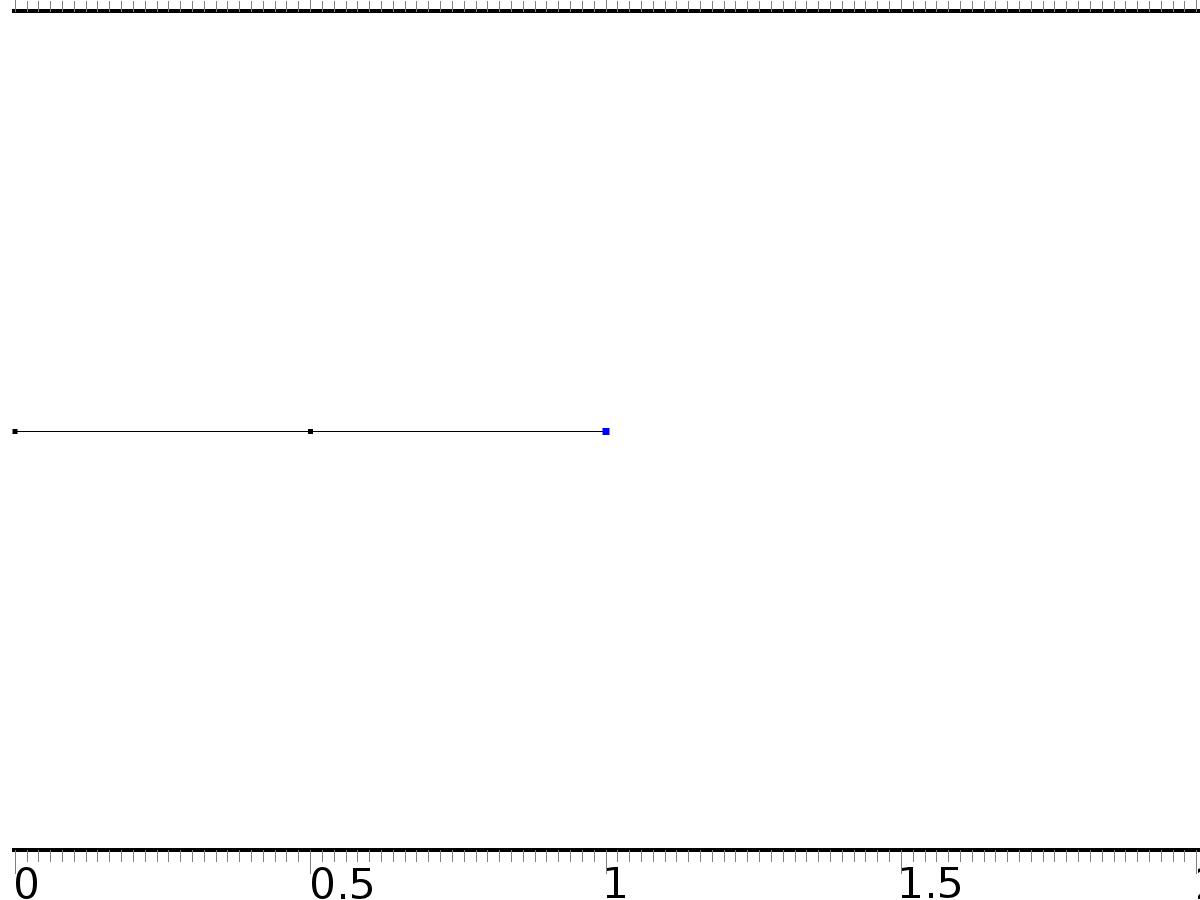
Settings

| **Description** | **Value** |
| --- | --- |
| Value on boundary | {d\_a4, d\_b4, d\_a4, d\_b4} |
| Prescribed value of a4 | On |
| Prescribed value of b4 | On |
| Prescribed value of at4 | On |
| Prescribed value of bt4 | On |
| Apply reaction terms on | Individual dependent variables |
| Use weak constraints | Off |
| Constraint method | Elemental |

#### Shape functions

| **Constraint** | **Constraint force** | **Shape function** | **Selection** |
| --- | --- | --- | --- |
| d\_a4-a4 | -test(a4) | Lagrange (Quadratic) | Boundary 1 |
| d\_b4-b4 | -test(b4) | Lagrange (Quadratic) | Boundary 1 |
| d\_a4-at4 | -test(at4) | Lagrange (Quadratic) | Boundary 1 |
| d\_b4-bt4 | -test(bt4) | Lagrange (Quadratic) | Boundary 1 |

* + 1. Bin\*Gamma4



Bin\*Gamma4

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | Boundary 3 |

Equations

Settings

| **Description** | **Value** |
| --- | --- |
| Boundary flux/source | {Gamma\_a4, Gamma\_b4, 0, 0} |
| Boundary absorption/impedance term | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |

#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| A4.g\_a4 | Gamma\_a4 |  | Boundary flux/source | Boundary 3 |
| A4.g\_b4 | Gamma\_b4 |  | Boundary flux/source | Boundary 3 |
| A4.g\_at4 | 0 |  | Boundary flux/source | Boundary 3 |
| A4.g\_bt4 | 0 |  | Boundary flux/source | Boundary 3 |

* 1. Regulator Equation PI5



Regulator Equation PI5

Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Domains 1–2 |

Settings

| **Description** | **Value** |
| --- | --- |
| Shape function type | Lagrange |
| Element order | Quadratic |
| Compute boundary fluxes | On |
| Apply smoothing to boundary fluxes | On |
| Value type when using splitting of complex variables | Complex |
| Dependent variable quantity | Dimensionless (1) |
| Source term quantity | None |
| Unit | m^ - 2 |

Used products

|  |
| --- |
| COMSOL Multiphysics |

Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| A5.nx | nx |  | Normal vector, x component | Boundaries 1–3 |
| A5.ny | root.ny |  | Normal vector, y component | Boundaries 1–3 |
| A5.nz | root.nz |  | Normal vector, z component | Boundaries 1–3 |
| A5.nxmesh | root.nxmesh |  | Normal vector (mesh), x component | Boundaries 1–3 |
| A5.nymesh | root.nymesh |  | Normal vector (mesh), y component | Boundaries 1–3 |
| A5.nzmesh | root.nzmesh |  | Normal vector (mesh), z component | Boundaries 1–3 |

* + 1. Coefficient Form PDE 1



Coefficient Form PDE 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Domains 1–2 |

Equations

Settings

| **Description** | **Value** |
| --- | --- |
| Diffusion coefficient | {{1, 0, 0, 0}, {0, 1, 0, 0}, {0, 0, 1, 0}, {0, 0, 0, 1}} |
| Absorption coefficient | {{0, -5\*alpha, 0, -5\*alpha}, {5\*alpha, 0, 5\*alpha, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Source term | {f\_a5, f\_b5, f\_a5, f\_b5} |
| Mass coefficient | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Damping or mass coefficient | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Conservative flux convection coefficient | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Convection coefficient | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |
| Conservative flux source | {0, 0, 0, 0} |

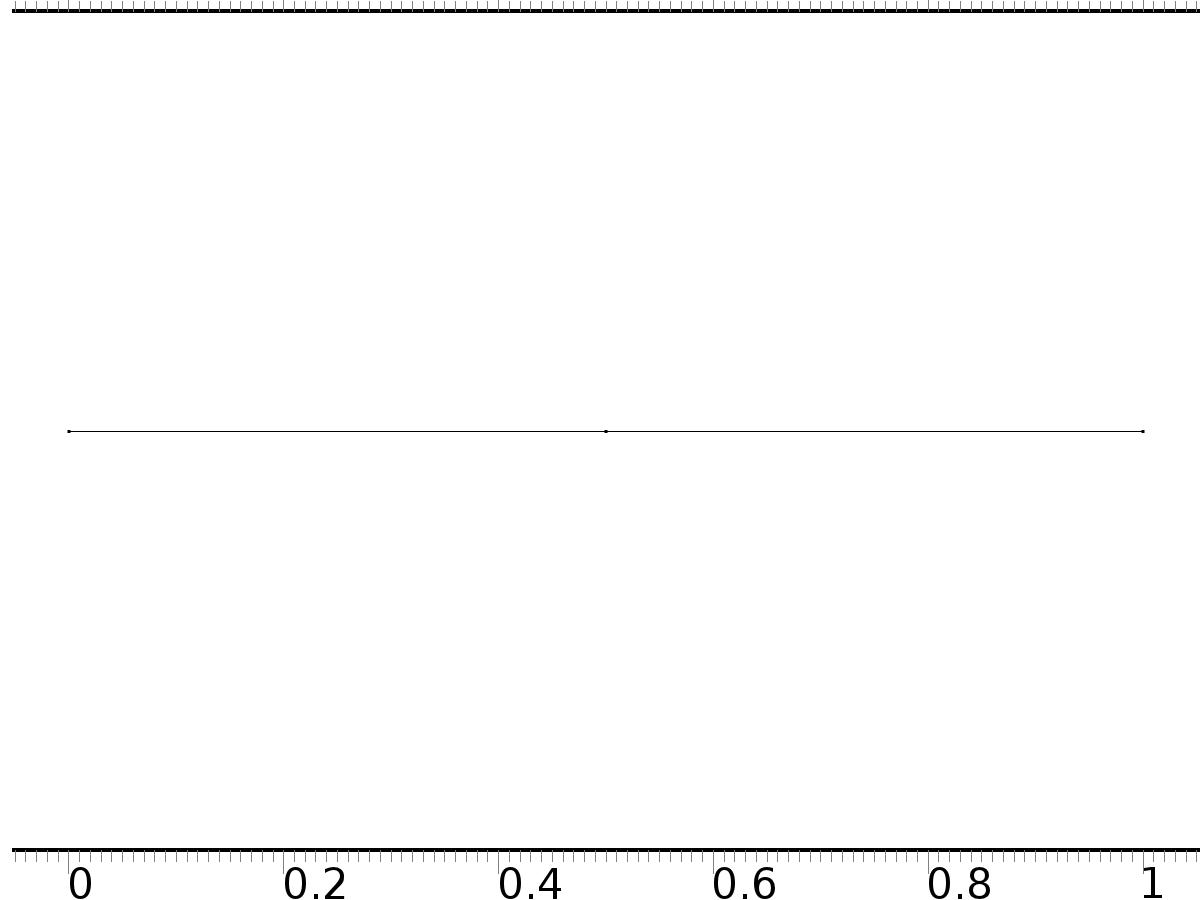
#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| domflux.a5x | -d(a5,x) |  | Domain flux, x component | Domains 1–2 |
| domflux.b5x | -d(b5,x) |  | Domain flux, x component | Domains 1–2 |
| domflux.at5x | -d(at5,x) |  | Domain flux, x component | Domains 1–2 |
| domflux.bt5x | -d(bt5,x) |  | Domain flux, x component | Domains 1–2 |

#### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| a5 | Lagrange (Quadratic) |  | Dependent variable a5 | Material | Domains 1–2 |
| b5 | Lagrange (Quadratic) |  | Dependent variable b5 | Material | Domains 1–2 |
| at5 | Lagrange (Quadratic) |  | Dependent variable at5 | Material | Domains 1–2 |
| bt5 | Lagrange (Quadratic) |  | Dependent variable bt5 | Material | Domains 1–2 |

* + 1. Zero Flux 1



Zero Flux 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | No boundaries |

Equations

* + 1. Initial Values 1



Initial Values 1

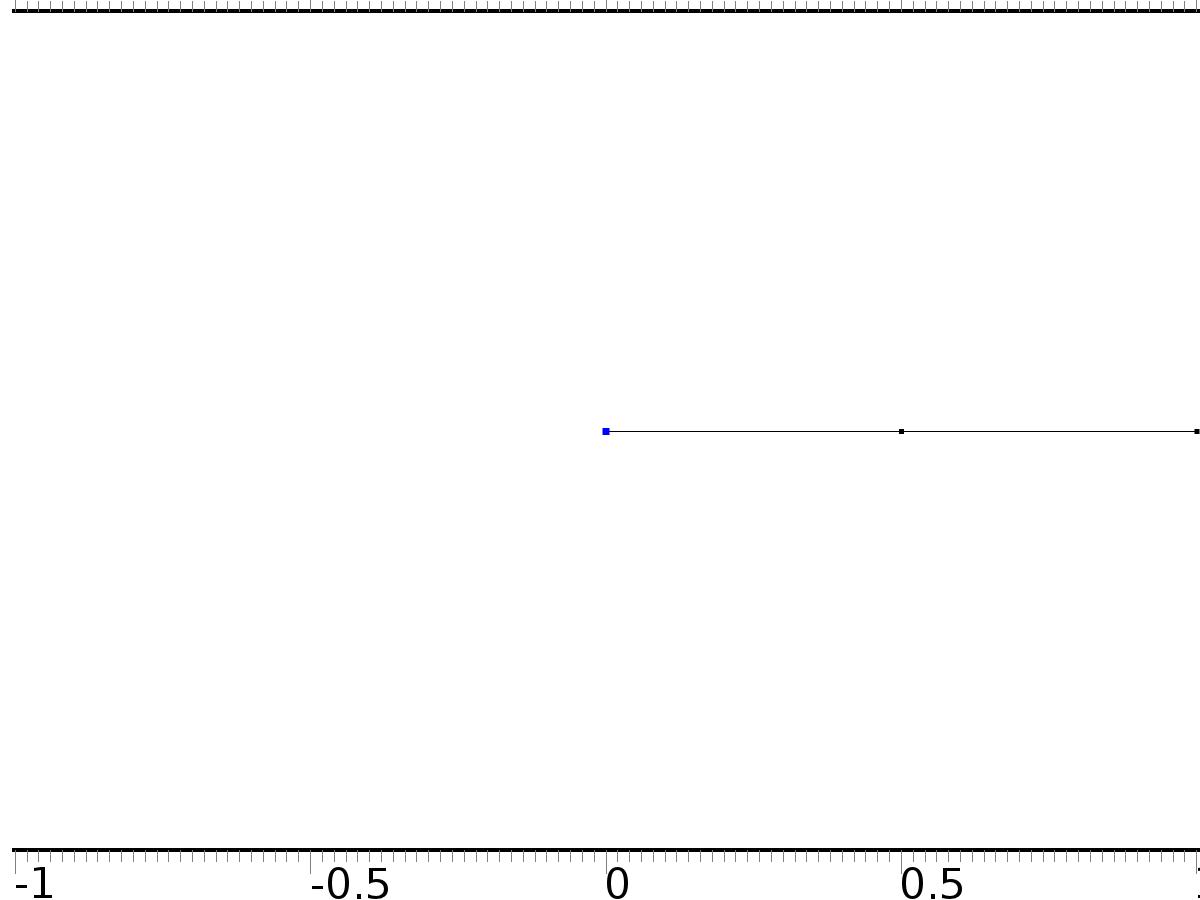
Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Domains 1–2 |

Settings

| **Description** | **Value** |
| --- | --- |
| Initial value for a5 | 0 |
| Initial value for b5 | 0 |
| Initial value for at5 | 0 |
| Initial value for bt5 | 0 |
| Initial time derivative of a5 | 0 |
| Initial time derivative of b5 | 0 |
| Initial time derivative of at5 | 0 |
| Initial time derivative of bt5 | 0 |

* + 1. Bd\*d5



Bd\*d5

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | Boundary 1 |

Equations

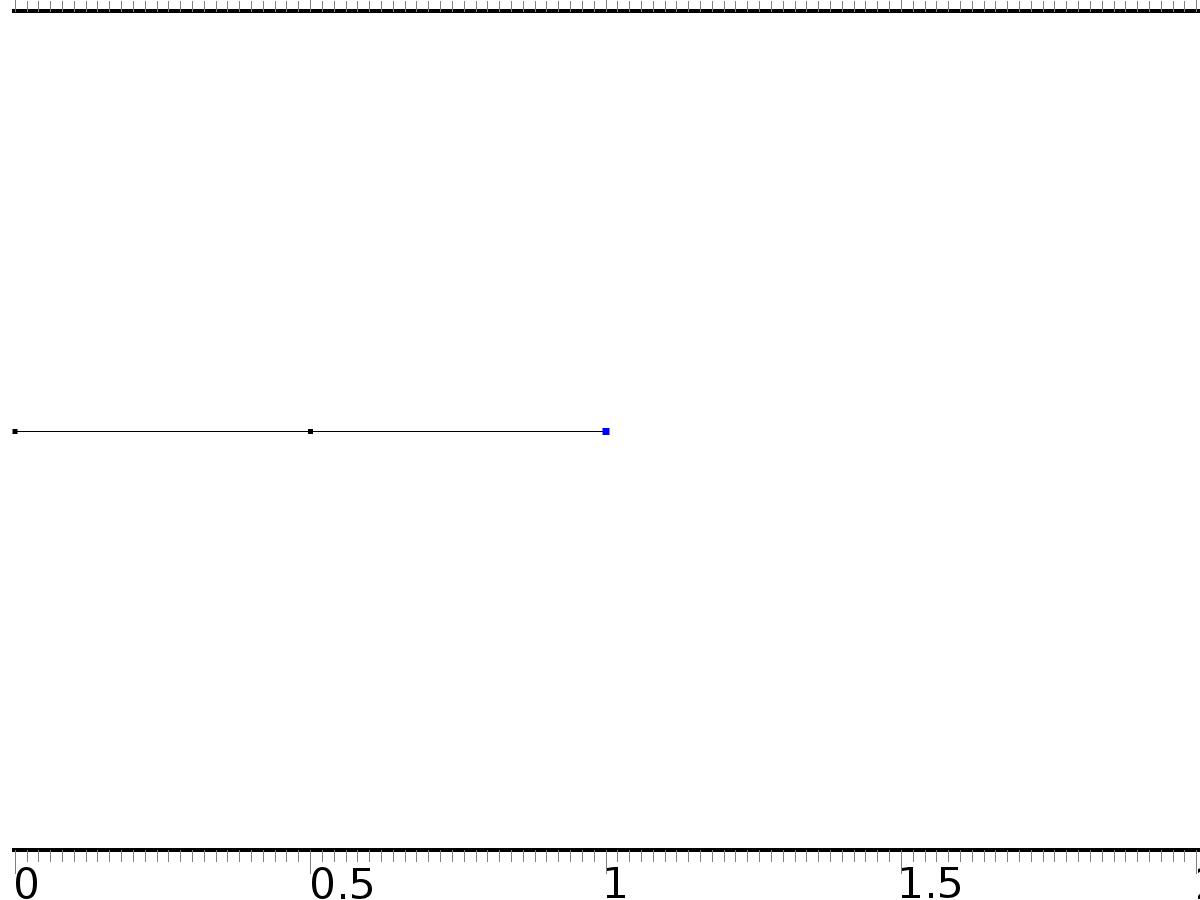
Settings

| **Description** | **Value** |
| --- | --- |
| Value on boundary | {d\_a5, d\_b5, d\_a5, d\_b5} |
| Prescribed value of a5 | On |
| Prescribed value of b5 | On |
| Prescribed value of at5 | On |
| Prescribed value of bt5 | On |
| Apply reaction terms on | Individual dependent variables |
| Use weak constraints | Off |
| Constraint method | Elemental |

#### Shape functions

| **Constraint** | **Constraint force** | **Shape function** | **Selection** |
| --- | --- | --- | --- |
| d\_a5-a5 | -test(a5) | Lagrange (Quadratic) | Boundary 1 |
| d\_b5-b5 | -test(b5) | Lagrange (Quadratic) | Boundary 1 |
| d\_a5-at5 | -test(at5) | Lagrange (Quadratic) | Boundary 1 |
| d\_b5-bt5 | -test(bt5) | Lagrange (Quadratic) | Boundary 1 |

* + 1. Bin\*Gamma5



Bin\*Gamma5

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | Boundary 3 |

Equations

Settings

| **Description** | **Value** |
| --- | --- |
| Boundary flux/source | {Gamma\_a5, Gamma\_b5, 0, 0} |
| Boundary absorption/impedance term | {{0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}} |

#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| A5.g\_a5 | Gamma\_a5 |  | Boundary flux/source | Boundary 3 |
| A5.g\_b5 | Gamma\_b5 |  | Boundary flux/source | Boundary 3 |
| A5.g\_at5 | 0 |  | Boundary flux/source | Boundary 3 |
| A5.g\_bt5 | 0 |  | Boundary flux/source | Boundary 3 |

* 1. Closed Loop System



Closed Loop System

Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Domains 1–2 |

Settings

| **Description** | **Value** |
| --- | --- |
| Shape function type | Lagrange |
| Element order | Quadratic |
| Compute boundary fluxes | On |
| Apply smoothing to boundary fluxes | On |
| Value type when using splitting of complex variables | Complex |
| Dependent variable quantity | Dimensionless (1) |
| Source term quantity | None |
| Unit | m^ - 2 |

Used products

|  |
| --- |
| COMSOL Multiphysics |

Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| z.nx | nx |  | Normal vector, x component | Boundaries 1–3 |
| z.ny | root.ny |  | Normal vector, y component | Boundaries 1–3 |
| z.nz | root.nz |  | Normal vector, z component | Boundaries 1–3 |
| z.nxmesh | root.nxmesh |  | Normal vector (mesh), x component | Boundaries 1–3 |
| z.nymesh | root.nymesh |  | Normal vector (mesh), y component | Boundaries 1–3 |
| z.nzmesh | root.nzmesh |  | Normal vector (mesh), z component | Boundaries 1–3 |

* + 1. Coefficient Form PDE 1



Coefficient Form PDE 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Domains 1–2 |

Equations

Settings

| **Description** | **Value** |
| --- | --- |
| Diffusion coefficient | 1 |
| Absorption coefficient | 0 |
| Source term | -z\*zx |
| Mass coefficient | 0 |
| Damping or mass coefficient | 1 |
| Conservative flux convection coefficient | 0 |
| Convection coefficient | 0 |
| Conservative flux source | 0 |

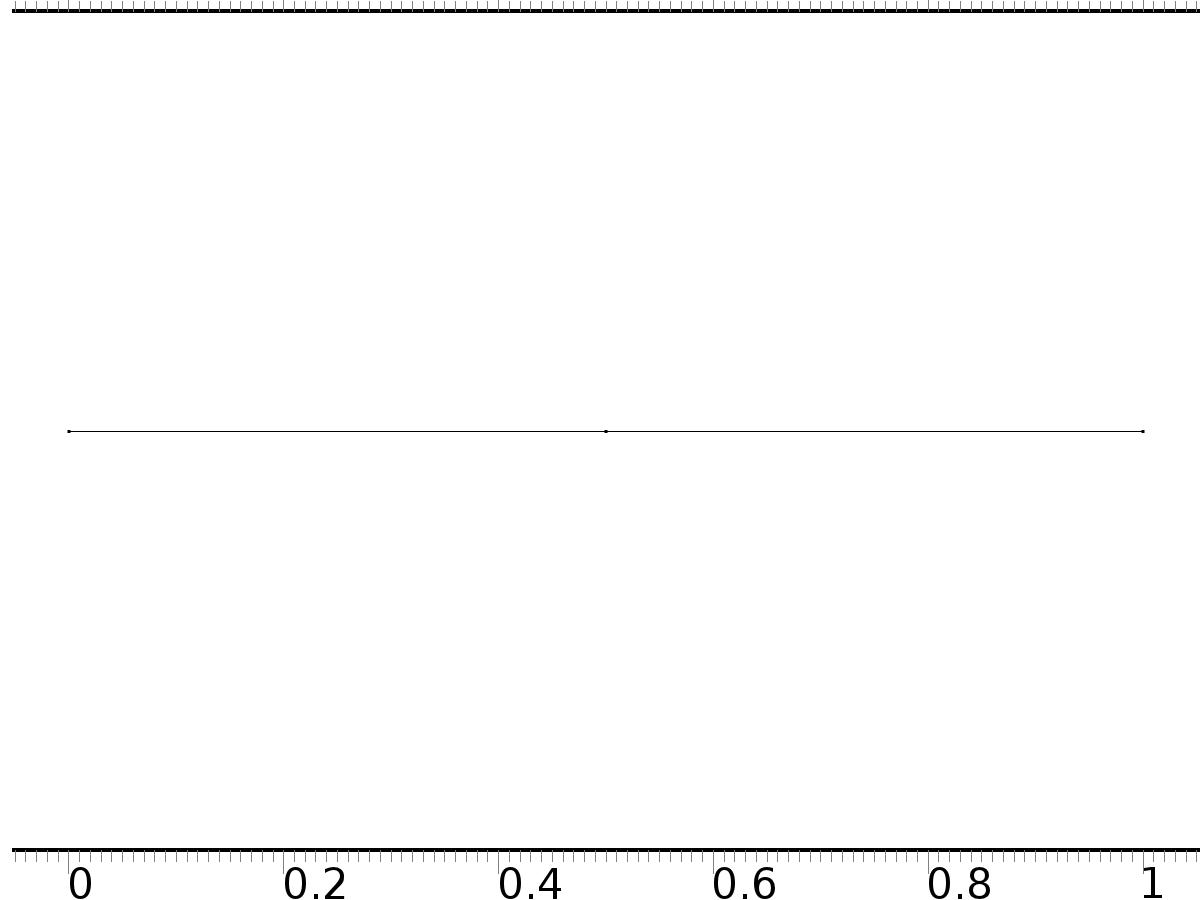
#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| domflux.zx | -d(z,x) |  | Domain flux, x component | Domains 1–2 |

#### Shape functions

| **Name** | **Shape function** | **Unit** | **Description** | **Shape frame** | **Selection** |
| --- | --- | --- | --- | --- | --- |
| z | Lagrange (Quadratic) |  | Dependent variable z | Material | Domains 1–2 |

* + 1. Zero Flux 1



Zero Flux 1

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | No boundaries |

Equations

* + 1. Initial Values 1



Initial Values 1

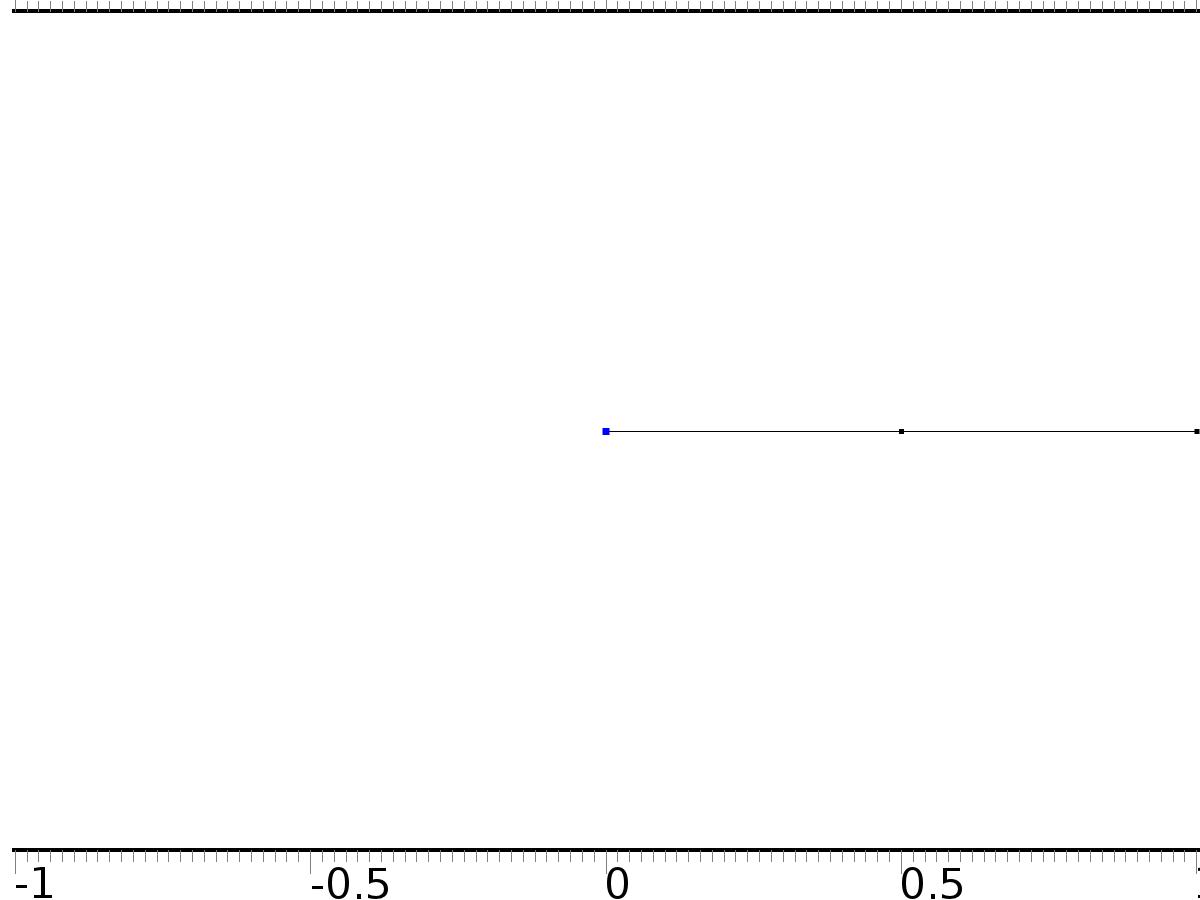
Selection

|  |  |
| --- | --- |
| Geometric entity level | Domain |
| Selection | Domains 1–2 |

Settings

| **Description** | **Value** |
| --- | --- |
| Initial value for z | M2 |
| Initial time derivative of z | 0 |

* + 1. Bd\*d



Bd\*d

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | Boundary 1 |

Equations

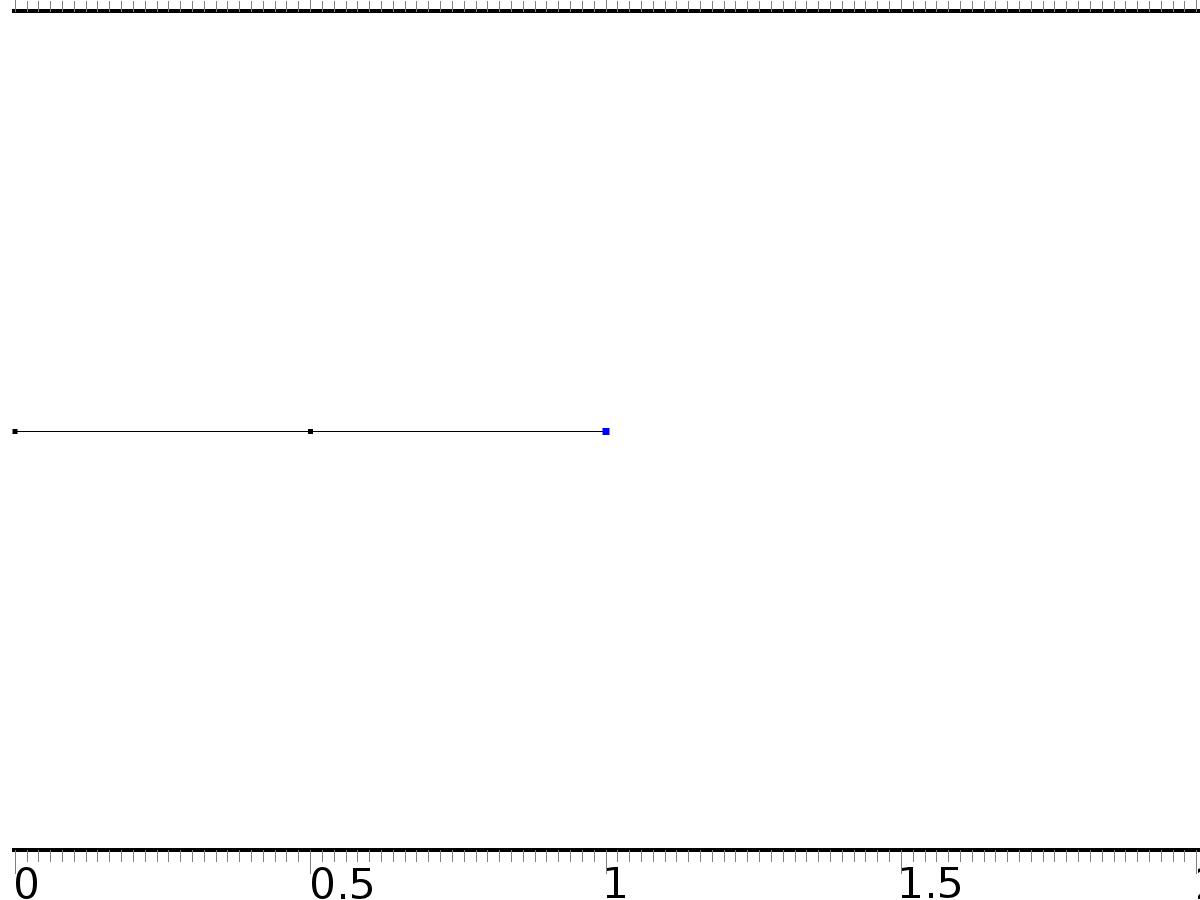
Settings

| **Description** | **Value** |
| --- | --- |
| Value on boundary | d |
| Prescribed value of z | On |
| Apply reaction terms on | Individual dependent variables |
| Use weak constraints | Off |
| Constraint method | Elemental |

#### Shape functions

| **Constraint** | **Constraint force** | **Shape function** | **Selection** |
| --- | --- | --- | --- |
| d-z | -test(z) | Lagrange (Quadratic) | Boundary 1 |

* + 1. Bin\*u



Bin\*u

Selection

|  |  |
| --- | --- |
| Geometric entity level | Boundary |
| Selection | Boundary 3 |

Equations

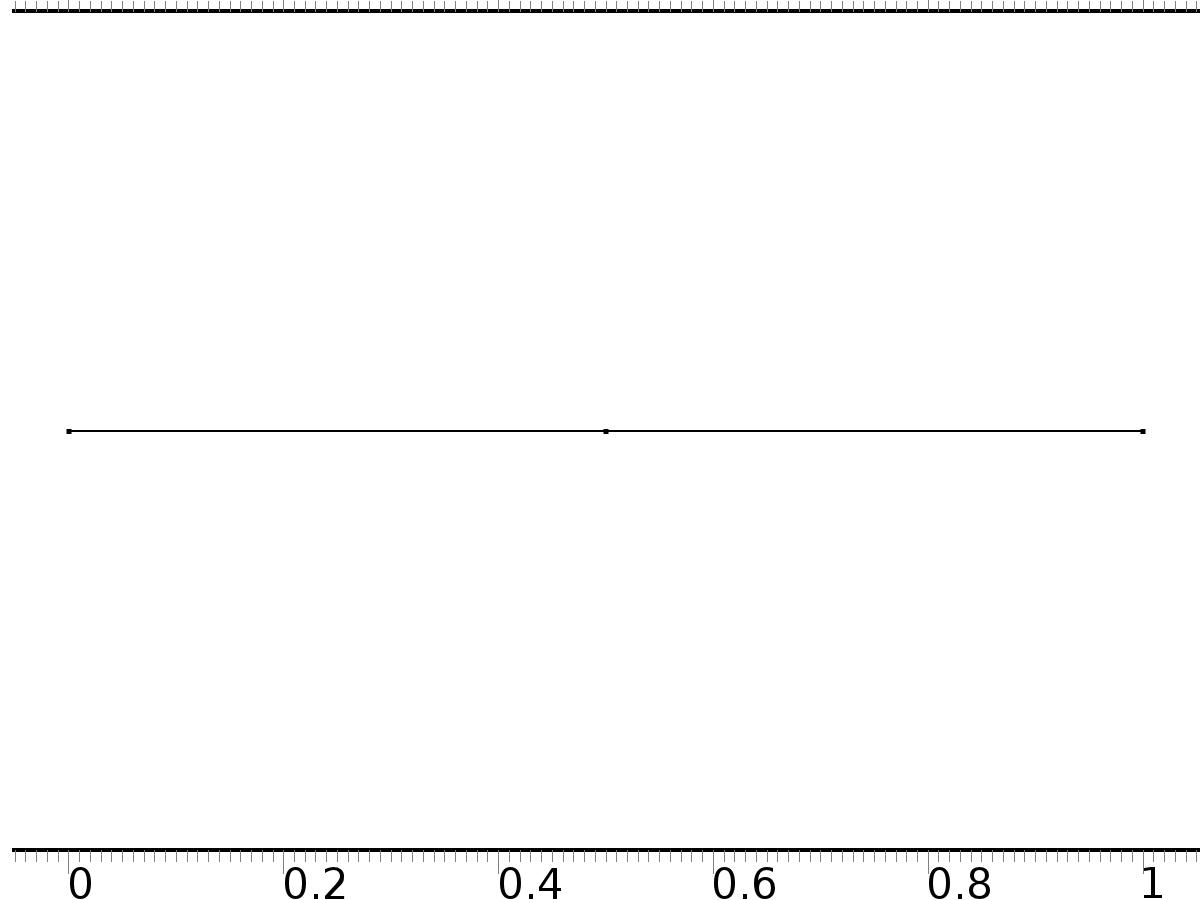
Settings

| **Description** | **Value** |
| --- | --- |
| Boundary flux/source | u |
| Boundary absorption/impedance term | 0 |

#### Variables

| **Name** | **Expression** | **Unit** | **Description** | **Selection** |
| --- | --- | --- | --- | --- |
| z.g\_z | u |  | Boundary flux/source | Boundary 3 |

* 1. Mesh 1



Mesh 1

* + 1. Size (size)

Settings

| **Description** | **Value** |
| --- | --- |
| Maximum element size | 0.067 |
| Minimum element size | 3.0E-4 |
| Curvature factor | 0.3 |
| Maximum element growth rate | 1.3 |

* + 1. Edge 1 (edg1)

Selection

|  |  |
| --- | --- |
| Geometric entity level | Remaining |

1. Study 1
   1. Stationary

Study settings

| **Description** | **Value** |
| --- | --- |
| Include geometric nonlinearity | Off |

Physics and variables selection

| **Physics interface** | **Discretization** |
| --- | --- |
| Unit input (c) | physics |

Mesh selection

| **Geometry** | **Mesh** |
| --- | --- |
| Geometry 1 (geom1) | mesh1 |

* 1. Solver Configurations
     1. Solver 1

#### Compile Equations: Stationary (st1)

Study and step

| **Description** | **Value** |
| --- | --- |
| Use study | Study 1 |
| Use study step | Stationary |

#### Dependent Variables 1 (v1)

General

| **Description** | **Value** |
| --- | --- |
| Defined by study step | Stationary |
| Constant |  |

Initial values of variables solved for

| **Description** | **Value** |
| --- | --- |
| Solution | Zero |

Values of variables not solved for

| **Description** | **Value** |
| --- | --- |
| Solution | Zero |

##### Dependent variable bt3 (mod1.bt3) (mod1\_bt3)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.bt3 |
| Solve for this field | Off |

##### Dependent variable bt2 (mod1.bt2) (mod1\_bt2)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.bt2 |
| Solve for this field | Off |

##### Dependent variable at3 (mod1.at3) (mod1\_at3)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.at3 |
| Solve for this field | Off |

##### Dependent variable b2 (mod1.b2) (mod1\_b2)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.b2 |
| Solve for this field | Off |

##### Dependent variable a3 (mod1.a3) (mod1\_a3)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.a3 |
| Solve for this field | Off |

##### Dependent variable b3 (mod1.b3) (mod1\_b3)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.b3 |
| Solve for this field | Off |

##### Dependent variable z (mod1.z) (mod1\_z)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.z |
| Solve for this field | Off |

##### Dependent variable X (mod1.X) (mod1\_X)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.X |

##### Dependent variable a1 (mod1.a1) (mod1\_a1)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.a1 |
| Solve for this field | Off |

##### Dependent variable a2 (mod1.a2) (mod1\_a2)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.a2 |
| Solve for this field | Off |

##### Dependent variable b1 (mod1.b1) (mod1\_b1)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.b1 |
| Solve for this field | Off |

##### Dependent variable a0 (mod1.a0) (mod1\_a0)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.a0 |
| Solve for this field | Off |

##### Dependent variable at2 (mod1.at2) (mod1\_at2)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.at2 |
| Solve for this field | Off |

##### Dependent variable at1 (mod1.at1) (mod1\_at1)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.at1 |
| Solve for this field | Off |

##### Dependent variable at0 (mod1.at0) (mod1\_at0)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.at0 |
| Solve for this field | Off |

##### Dependent variable bt1 (mod1.bt1) (mod1\_bt1)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.bt1 |
| Solve for this field | Off |

##### Dependent variable bt4 (mod1.bt4) (mod1\_bt4)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.bt4 |
| Solve for this field | Off |

##### Dependent variable at4 (mod1.at4) (mod1\_at4)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.at4 |
| Solve for this field | Off |

##### Dependent variable a4 (mod1.a4) (mod1\_a4)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.a4 |
| Solve for this field | Off |

##### Dependent variable b4 (mod1.b4) (mod1\_b4)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.b4 |
| Solve for this field | Off |

##### Dependent variable bt5 (mod1.bt5) (mod1\_bt5)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.bt5 |
| Solve for this field | Off |

##### Dependent variable at5 (mod1.at5) (mod1\_at5)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.at5 |
| Solve for this field | Off |

##### Dependent variable a5 (mod1.a5) (mod1\_a5)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.a5 |
| Solve for this field | Off |

##### Dependent variable b5 (mod1.b5) (mod1\_b5)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.b5 |
| Solve for this field | Off |

#### Stationary Solver 1 (s1)

General

| **Description** | **Value** |
| --- | --- |
| Defined by study step | Stationary |
| Relative tolerance | 0.000010 |

Log

| **Description** | **Value** |
| --- | --- |
| Constant |  |

##### Fully Coupled 1 (fc1)

General

| **Description** | **Value** |
| --- | --- |
| Linear solver | Direct |

1. Study 2
   1. Stationary

Study settings

| **Description** | **Value** |
| --- | --- |
| Include geometric nonlinearity | Off |

Physics and variables selection

| **Physics interface** | **Discretization** |
| --- | --- |
| Regulator Equation PI0 (c2) | physics |
| Regulator Equation PI1 (c3) | physics |
| Regulator Equation PI2 (c4) | physics |
| Regulator Equation PI3 (c6) | physics |
| Regulator Equation PI4 (phys1) | physics |
| Regulator Equation PI5 (c7) | physics |

Mesh selection

| **Geometry** | **Mesh** |
| --- | --- |
| Geometry 1 (geom1) | mesh1 |

* 1. Solver Configurations
     1. Solver 2

#### Compile Equations: Stationary (st1)

Study and step

| **Description** | **Value** |
| --- | --- |
| Use study | Study 2 |
| Use study step | Stationary |

#### Dependent Variables 1 (v1)

General

| **Description** | **Value** |
| --- | --- |
| Defined by study step | Stationary |
| Constant |  |

Initial values of variables solved for

| **Description** | **Value** |
| --- | --- |
| Solution | Zero |

Values of variables not solved for

| **Description** | **Value** |
| --- | --- |
| Method | Solution |
| Solution | Solver 1 |

##### Dependent variable bt5 (mod1.bt5) (mod1\_bt5)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.bt5 |

##### Dependent variable bt4 (mod1.bt4) (mod1\_bt4)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.bt4 |

##### Dependent variable bt3 (mod1.bt3) (mod1\_bt3)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.bt3 |

##### Dependent variable bt2 (mod1.bt2) (mod1\_bt2)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.bt2 |

##### Dependent variable at5 (mod1.at5) (mod1\_at5)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.at5 |

##### Dependent variable at3 (mod1.at3) (mod1\_at3)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.at3 |

##### Dependent variable at4 (mod1.at4) (mod1\_at4)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.at4 |

##### Dependent variable a5 (mod1.a5) (mod1\_a5)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.a5 |

##### Dependent variable b2 (mod1.b2) (mod1\_b2)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.b2 |

##### Dependent variable a3 (mod1.a3) (mod1\_a3)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.a3 |

##### Dependent variable a4 (mod1.a4) (mod1\_a4)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.a4 |

##### Dependent variable b3 (mod1.b3) (mod1\_b3)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.b3 |

##### Dependent variable z (mod1.z) (mod1\_z)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.z |
| Solve for this field | Off |

##### Dependent variable b4 (mod1.b4) (mod1\_b4)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.b4 |

##### Dependent variable X (mod1.X) (mod1\_X)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.X |
| Solve for this field | Off |

##### Dependent variable a1 (mod1.a1) (mod1\_a1)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.a1 |

##### Dependent variable b5 (mod1.b5) (mod1\_b5)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.b5 |

##### Dependent variable a2 (mod1.a2) (mod1\_a2)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.a2 |

##### Dependent variable b1 (mod1.b1) (mod1\_b1)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.b1 |

##### Dependent variable a0 (mod1.a0) (mod1\_a0)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.a0 |

##### Dependent variable at2 (mod1.at2) (mod1\_at2)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.at2 |

##### Dependent variable at1 (mod1.at1) (mod1\_at1)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.at1 |

##### Dependent variable at0 (mod1.at0) (mod1\_at0)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.at0 |

##### Dependent variable bt1 (mod1.bt1) (mod1\_bt1)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.bt1 |

#### Stationary Solver 1 (s1)

General

| **Description** | **Value** |
| --- | --- |
| Defined by study step | Stationary |

Log

| **Description** | **Value** |
| --- | --- |
| Constant |  |

##### Fully Coupled 1 (fc1)

General

| **Description** | **Value** |
| --- | --- |
| Linear solver | Direct |

1. Study 3
   1. Time Dependent

Study settings

| **Description** | **Value** |
| --- | --- |
| Include geometric nonlinearity | Off |

| **Times** | **Unit** |
| --- | --- |
| range(0,0.1,10) | s |

Physics and variables selection

| **Physics interface** | **Discretization** |
| --- | --- |
| Closed Loop System (c5) | physics |

Mesh selection

| **Geometry** | **Mesh** |
| --- | --- |
| Geometry 1 (geom1) | mesh1 |

* 1. Solver Configurations
     1. Solver 3

#### Compile Equations: Time Dependent (st1)

Study and step

| **Description** | **Value** |
| --- | --- |
| Use study | Study 3 |
| Use study step | Time Dependent |

#### Dependent Variables 1 (v1)

General

| **Description** | **Value** |
| --- | --- |
| Defined by study step | Time Dependent |
| Constant |  |

Initial values of variables solved for

| **Description** | **Value** |
| --- | --- |
| Solution | Zero |

Values of variables not solved for

| **Description** | **Value** |
| --- | --- |
| Method | Solution |
| Solution | Solver 2 |

##### Dependent variable bt5 (mod1.bt5) (mod1\_bt5)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.bt5 |
| Solve for this field | Off |

##### Dependent variable bt4 (mod1.bt4) (mod1\_bt4)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.bt4 |
| Solve for this field | Off |

##### Dependent variable bt3 (mod1.bt3) (mod1\_bt3)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.bt3 |
| Solve for this field | Off |

##### Dependent variable bt2 (mod1.bt2) (mod1\_bt2)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.bt2 |
| Solve for this field | Off |

##### Dependent variable at5 (mod1.at5) (mod1\_at5)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.at5 |
| Solve for this field | Off |

##### Dependent variable at3 (mod1.at3) (mod1\_at3)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.at3 |
| Solve for this field | Off |

##### Dependent variable at4 (mod1.at4) (mod1\_at4)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.at4 |
| Solve for this field | Off |

##### Dependent variable a5 (mod1.a5) (mod1\_a5)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.a5 |
| Solve for this field | Off |

##### Dependent variable b2 (mod1.b2) (mod1\_b2)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.b2 |
| Solve for this field | Off |

##### Dependent variable a3 (mod1.a3) (mod1\_a3)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.a3 |
| Solve for this field | Off |

##### Dependent variable a4 (mod1.a4) (mod1\_a4)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.a4 |
| Solve for this field | Off |

##### Dependent variable b3 (mod1.b3) (mod1\_b3)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.b3 |
| Solve for this field | Off |

##### Dependent variable z (mod1.z) (mod1\_z)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.z |

##### Dependent variable b4 (mod1.b4) (mod1\_b4)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.b4 |
| Solve for this field | Off |

##### Dependent variable X (mod1.X) (mod1\_X)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.X |
| Solve for this field | Off |

##### Dependent variable a1 (mod1.a1) (mod1\_a1)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.a1 |
| Solve for this field | Off |

##### Dependent variable b5 (mod1.b5) (mod1\_b5)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.b5 |
| Solve for this field | Off |

##### Dependent variable a2 (mod1.a2) (mod1\_a2)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.a2 |
| Solve for this field | Off |

##### Dependent variable b1 (mod1.b1) (mod1\_b1)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.b1 |
| Solve for this field | Off |

##### Dependent variable a0 (mod1.a0) (mod1\_a0)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.a0 |
| Solve for this field | Off |

##### Dependent variable at2 (mod1.at2) (mod1\_at2)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.at2 |
| Solve for this field | Off |

##### Dependent variable at1 (mod1.at1) (mod1\_at1)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.at1 |
| Solve for this field | Off |

##### Dependent variable at0 (mod1.at0) (mod1\_at0)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.at0 |
| Solve for this field | Off |

##### Dependent variable bt1 (mod1.bt1) (mod1\_bt1)

General

| **Description** | **Value** |
| --- | --- |
| Field components | mod1.bt1 |
| Solve for this field | Off |

#### Time-Dependent Solver 1 (t1)

General

| **Description** | **Value** |
| --- | --- |
| Defined by study step | Time Dependent |
| Time | {0, 0.1, 0.2, 0.30000000000000004, 0.4, 0.5, 0.6000000000000001, 0.7000000000000001, 0.8, 0.9, 1, 1.1, 1.2000000000000002, 1.3, 1.4000000000000001, 1.5, 1.6, 1.7000000000000002, 1.8, 1.9000000000000001, 2, 2.1, 2.2, 2.3000000000000003, 2.4000000000000004, 2.5, 2.6, 2.7, 2.8000000000000003, 2.9000000000000004, 3, 3.1, 3.2, 3.3000000000000003, 3.4000000000000004, 3.5, 3.6, 3.7, 3.8000000000000003, 3.9000000000000004, 4, 4.1000000000000005, 4.2, 4.3, 4.4, 4.5, 4.6000000000000005, 4.7, 4.800000000000001, 4.9, 5, 5.1000000000000005, 5.2, 5.300000000000001, 5.4, 5.5, 5.6000000000000005, 5.7, 5.800000000000001, 5.9, 6, 6.1000000000000005, 6.2, 6.300000000000001, 6.4, 6.5, 6.6000000000000005, 6.7, 6.800000000000001, 6.9, 7, 7.1000000000000005, 7.2, 7.300000000000001, 7.4, 7.5, 7.6000000000000005, 7.7, 7.800000000000001, 7.9, 8, 8.1, 8.200000000000001, 8.3, 8.4, 8.5, 8.6, 8.700000000000001, 8.8, 8.9, 9, 9.1, 9.200000000000001, 9.3, 9.4, 9.5, 9.600000000000001, 9.700000000000001, 9.8, 9.9, 10} |
| Relative tolerance | 0.0001 |

Absolute tolerance

| **Description** | **Value** |
| --- | --- |
| Tolerance | 0.000010 |

Time stepping

| **Description** | **Value** |
| --- | --- |
| Initial step | 0.0010 |

Advanced

| **Description** | **Value** |
| --- | --- |
| Fraction of initial step for Backward Euler | 0.0010 |

Log

| **Description** | **Value** |
| --- | --- |
| Constant |  |

##### Fully Coupled 1 (fc1)

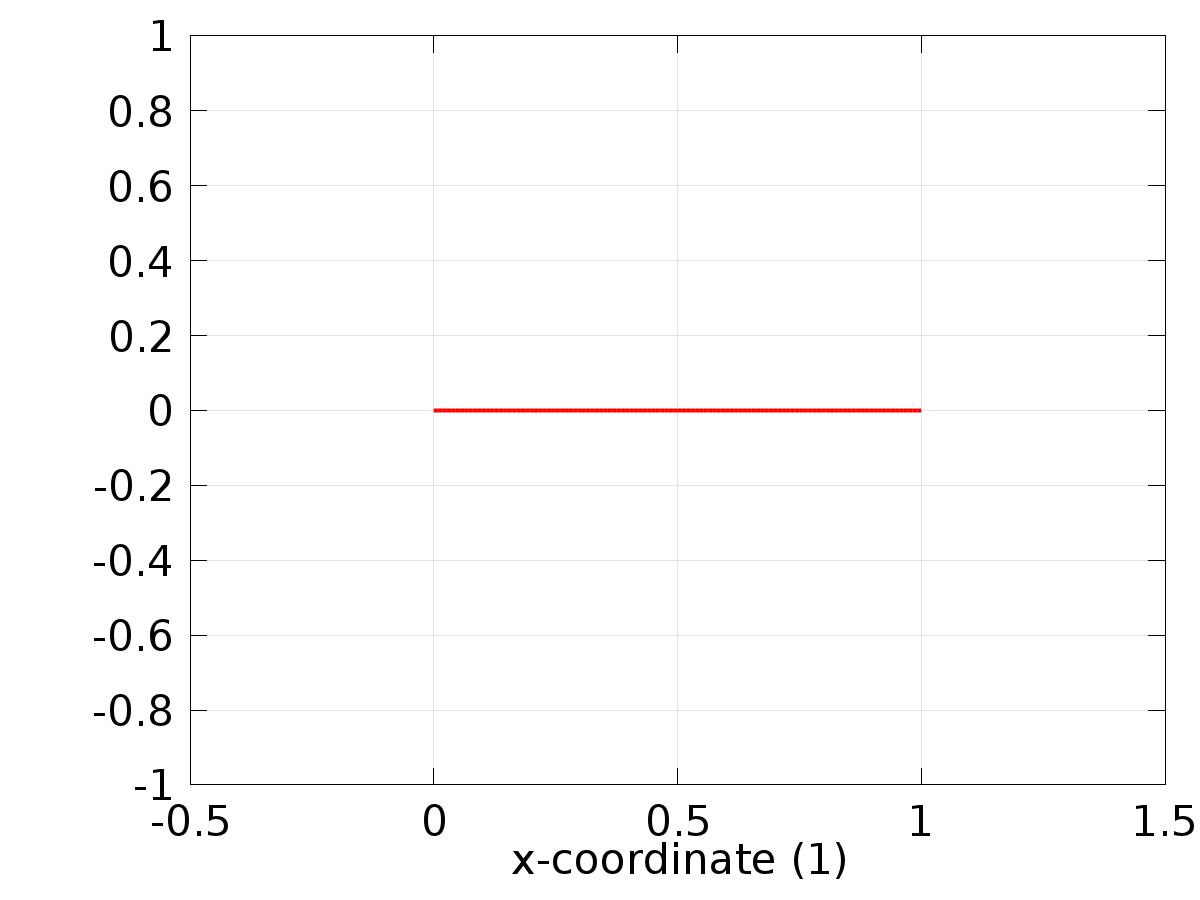
General

| **Description** | **Value** |
| --- | --- |
| Linear solver | Direct |

1. Results
   1. Data Sets
      1. Solution 1

Solution

| **Description** | **Value** |
| --- | --- |
| Solution | Solver 1 |
| Component | Save Point Geometry 1 |

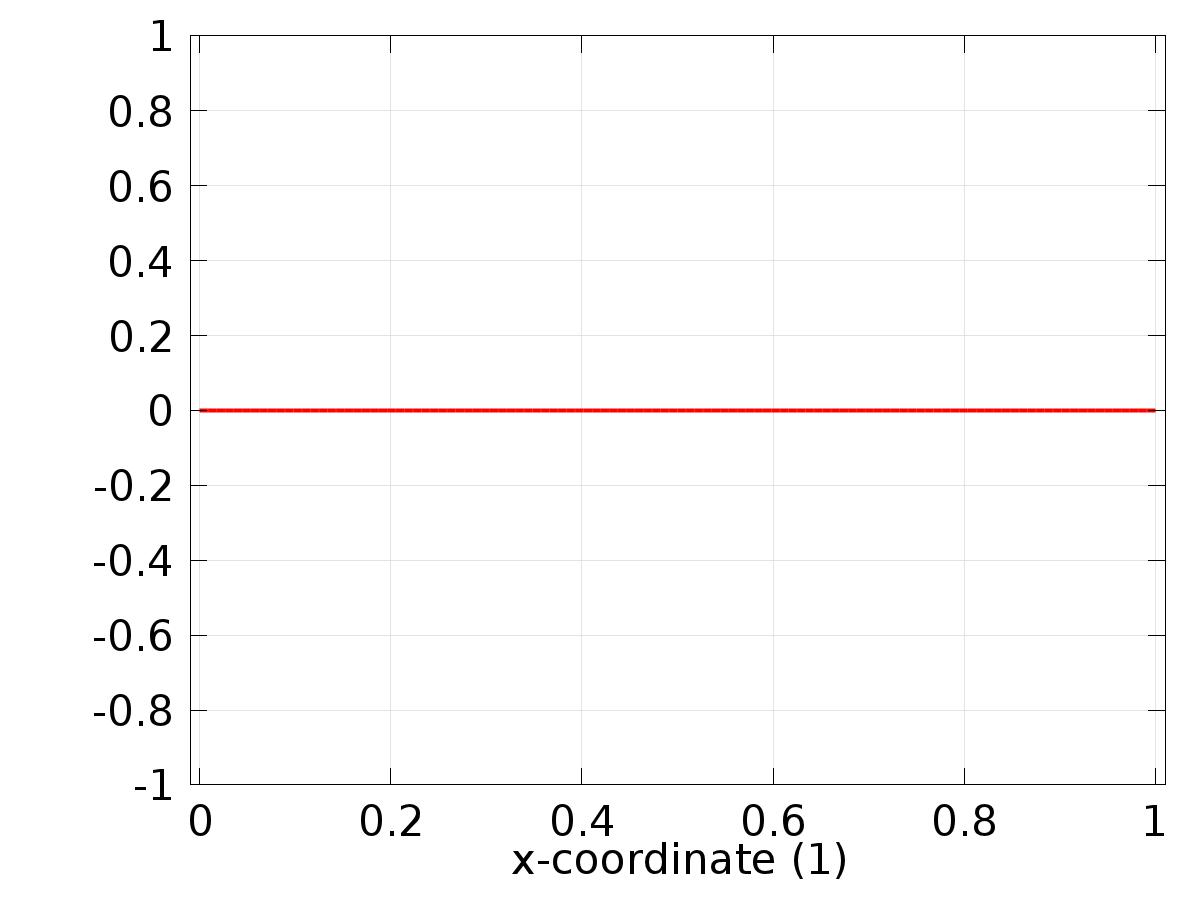


Data set: Solution 1

* + 1. Solution 2

Solution

| **Description** | **Value** |
| --- | --- |
| Solution | Solver 2 |
| Component | Save Point Geometry 1 |

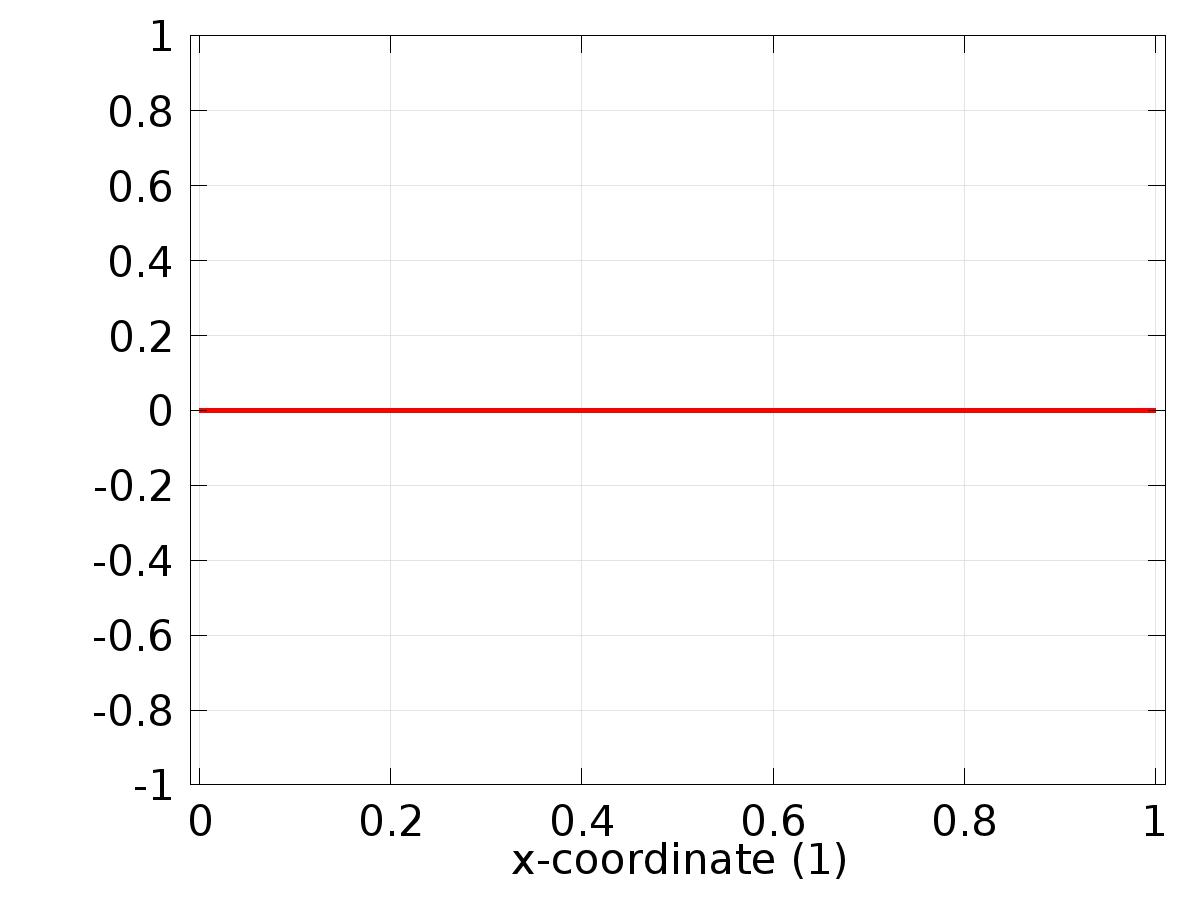


Data set: Solution 2

* + 1. Solution 3

Solution

| **Description** | **Value** |
| --- | --- |
| Solution | Solver 3 |
| Component | Save Point Geometry 1 |



Data set: Solution 3

* 1. Derived Values
     1. Global Evaluation 1

Data

| **Description** | **Value** |
| --- | --- |
| Data set | Solution 3 |

Expression

| **Description** | **Value** |
| --- | --- |
| Expression | d |

* 1. Tables
     1. Table 1

Global Evaluation 1 (Gamma\_a0)

Table 1

| **Gamma\_a0 (1)** | **Gamma\_a1 (1)** | **Gamma\_b1 (1)** | **Gamma\_a2 (1)** | **Gamma\_b2 (1)** |
| --- | --- | --- | --- | --- |
| 1.4437 | 0.28111 | 0.79129 | -0.085978 | 0.029103 |

* + 1. Table 2

Point Evaluation 1 (yr)

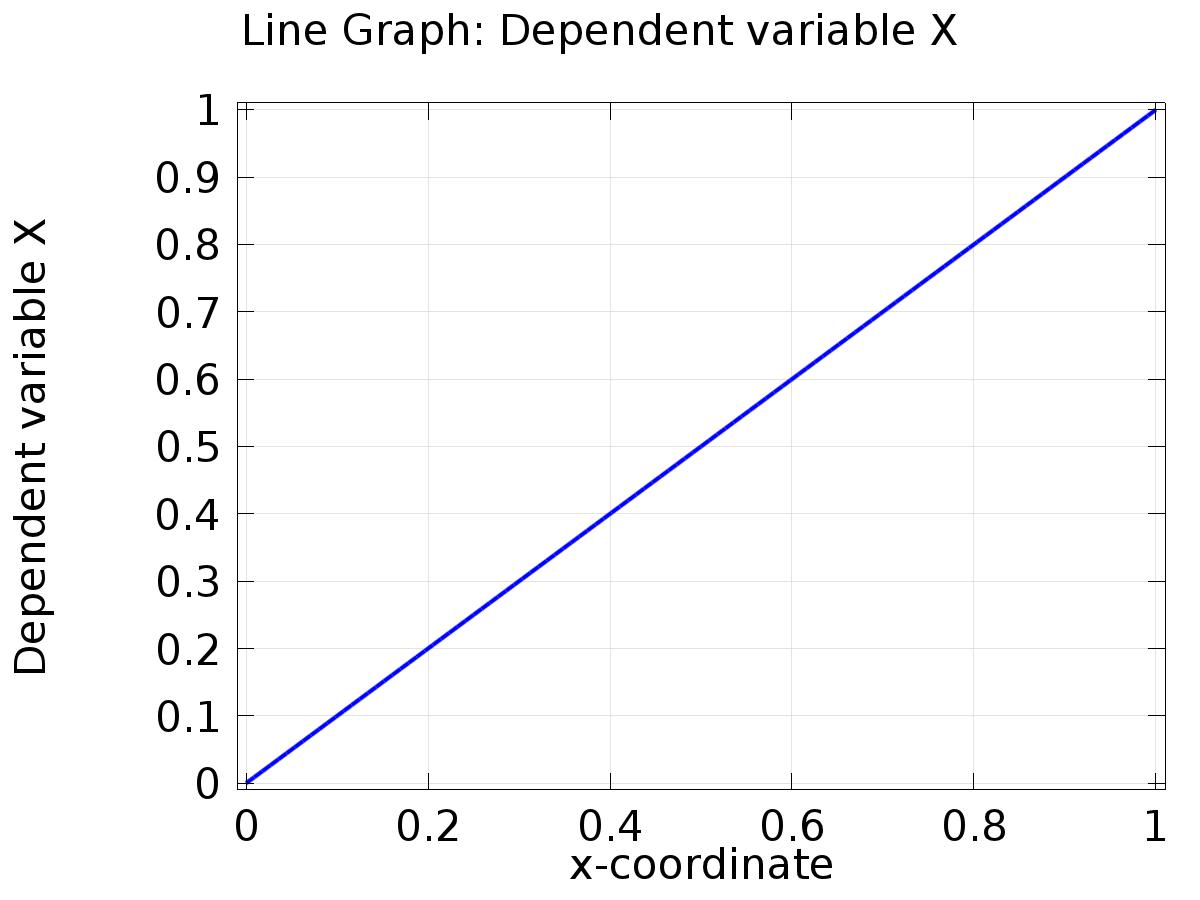
* + 1. Table 3

Global Evaluation 1 (C(z))

Table 3

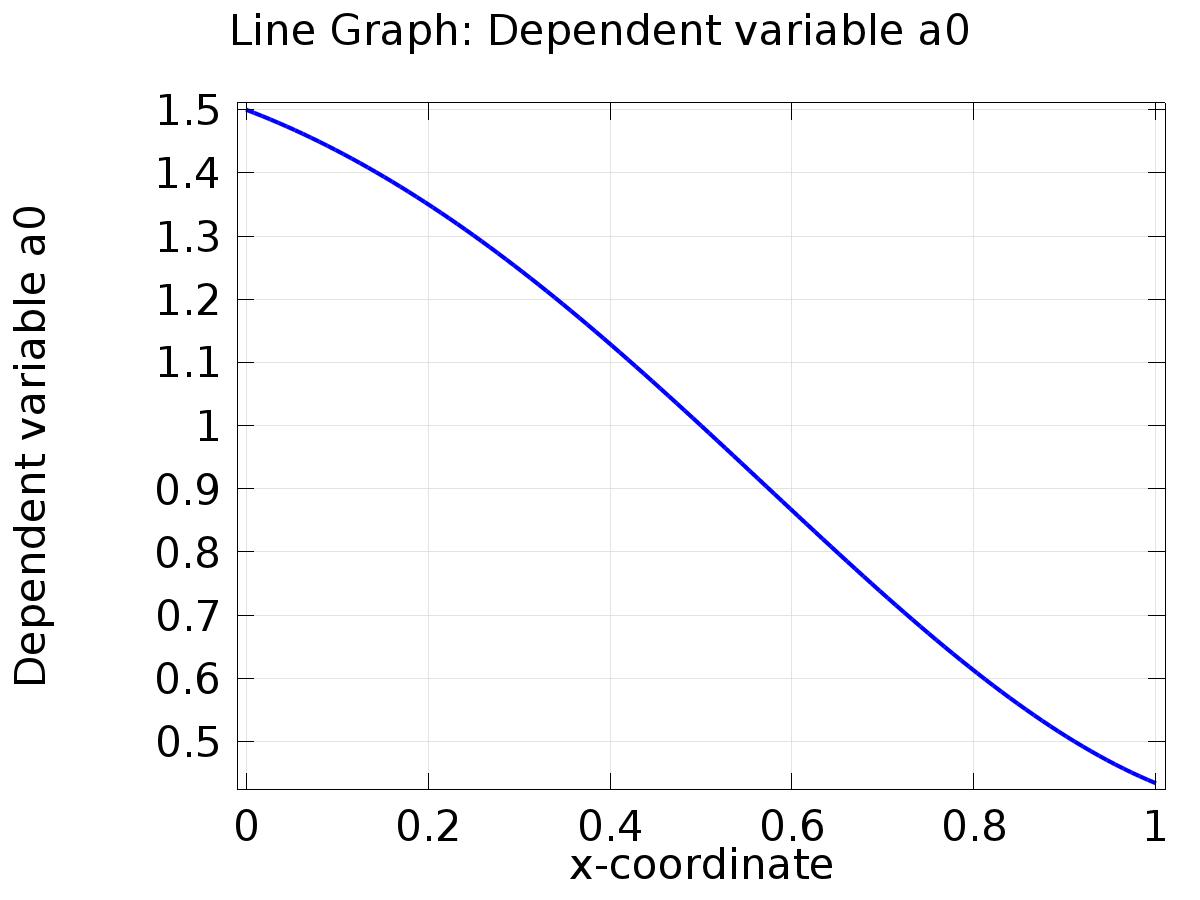
| **Time (s)** | **C(z)** | **yr** | **e** | **d** |
| --- | --- | --- | --- | --- |
| 0.0000 | 0.75000 | 0.50000 | -0.25000 | 0.75000 |
| 0.10000 | 0.79069 | 0.64695 | -0.14375 | 1.0590 |
| 0.20000 | 0.84367 | 0.73776 | -0.10590 | 1.3378 |
| 0.30000 | 0.82779 | 0.73776 | -0.090027 | 1.5590 |
| 0.40000 | 0.73413 | 0.64695 | -0.087186 | 1.7011 |
| 0.50000 | 0.59275 | 0.50000 | -0.092753 | 1.7500 |
| 0.60000 | 0.45463 | 0.35305 | -0.10158 | 1.7011 |
| 0.70000 | 0.37066 | 0.26224 | -0.10843 | 1.5590 |
| 0.80000 | 0.37034 | 0.26224 | -0.10811 | 1.3378 |
| 0.90000 | 0.44891 | 0.35305 | -0.095858 | 1.0590 |
| 1.0000 | 0.57425 | 0.50000 | -0.074247 | 0.75000 |
| 1.1000 | 0.69817 | 0.64695 | -0.051219 | 0.44098 |
| 1.2000 | 0.76955 | 0.73776 | -0.031790 | 0.16221 |
| 1.3000 | 0.75621 | 0.73776 | -0.018448 | -0.059017 |
| 1.4000 | 0.65841 | 0.64695 | -0.011459 | -0.20106 |
| 1.5000 | 0.50755 | 0.50000 | -0.0075469 | -0.25000 |
| 1.6000 | 0.35769 | 0.35305 | -0.0046361 | -0.20106 |
| 1.7000 | 0.26571 | 0.26224 | -0.0034722 | -0.059017 |
| 1.8000 | 0.26513 | 0.26224 | -0.0028915 | 0.16221 |
| 1.9000 | 0.35474 | 0.35305 | -0.0016844 | 0.44098 |
| 2.0000 | 0.50115 | 0.50000 | -0.0011512 | 0.75000 |
| 2.1000 | 0.64808 | 0.64695 | -0.0011357 | 1.0590 |
| 2.2000 | 0.73856 | 0.73776 | -7.9475E-4 | 1.3378 |
| 2.3000 | 0.73818 | 0.73776 | -4.1279E-4 | 1.5590 |
| 2.4000 | 0.64754 | 0.64695 | -5.9334E-4 | 1.7011 |
| 2.5000 | 0.50094 | 0.50000 | -9.3640E-4 | 1.7500 |
| 2.6000 | 0.35376 | 0.35305 | -7.0643E-4 | 1.7011 |
| 2.7000 | 0.26272 | 0.26224 | -4.8000E-4 | 1.5590 |
| 2.8000 | 0.26325 | 0.26224 | -0.0010094 | 1.3378 |
| 2.9000 | 0.35390 | 0.35305 | -8.4245E-4 | 1.0590 |
| 3.0000 | 0.50023 | 0.50000 | -2.2586E-4 | 0.75000 |
| 3.1000 | 0.64757 | 0.64695 | -6.1994E-4 | 0.44098 |
| 3.2000 | 0.73820 | 0.73776 | -4.4020E-4 | 0.16221 |
| 3.3000 | 0.73761 | 0.73776 | 1.5431E-4 | -0.059017 |
| 3.4000 | 0.64714 | 0.64695 | -1.9539E-4 | -0.20106 |
| 3.5000 | 0.50030 | 0.50000 | -3.0217E-4 | -0.25000 |
| 3.6000 | 0.35275 | 0.35305 | 3.0087E-4 | -0.20106 |
| 3.7000 | 0.26221 | 0.26224 | 2.8591E-5 | -0.059017 |
| 3.8000 | 0.26256 | 0.26224 | -3.2465E-4 | 0.16221 |
| 3.9000 | 0.35291 | 0.35305 | 1.4739E-4 | 0.44098 |
| 4.0000 | 0.49982 | 0.50000 | 1.8039E-4 | 0.75000 |
| 4.1000 | 0.64716 | 0.64695 | -2.1095E-4 | 1.0590 |
| 4.2000 | 0.73782 | 0.73776 | -5.5936E-5 | 1.3378 |
| 4.3000 | 0.73754 | 0.73776 | 2.2745E-4 | 1.5590 |
| 4.4000 | 0.64687 | 0.64695 | 7.4143E-5 | 1.7011 |
| 4.5000 | 0.50021 | 0.50000 | -2.0789E-4 | 1.7500 |
| 4.6000 | 0.35297 | 0.35305 | 8.6958E-5 | 1.7011 |
| 4.7000 | 0.26188 | 0.26224 | 3.5675E-4 | 1.5590 |
| 4.8000 | 0.26240 | 0.26224 | -1.5922E-4 | 1.3378 |
| 4.9000 | 0.35312 | 0.35305 | -6.6960E-5 | 1.0590 |
| 5.0000 | 0.49962 | 0.50000 | 3.7948E-4 | 0.75000 |
| 5.1000 | 0.64709 | 0.64695 | -1.4312E-4 | 0.44098 |
| 5.2000 | 0.73791 | 0.73776 | -1.4946E-4 | 0.16221 |
| 5.3000 | 0.73738 | 0.73776 | 3.8507E-4 | -0.059017 |
| 5.4000 | 0.64698 | 0.64695 | -3.0726E-5 | -0.20106 |
| 5.5000 | 0.50024 | 0.50000 | -2.3751E-4 | -0.25000 |
| 5.6000 | 0.35274 | 0.35305 | 3.1733E-4 | -0.20106 |
| 5.7000 | 0.26218 | 0.26224 | 5.4803E-5 | -0.059017 |
| 5.8000 | 0.26255 | 0.26224 | -3.1068E-4 | 0.16221 |
| 5.9000 | 0.35289 | 0.35305 | 1.6055E-4 | 0.44098 |
| 6.0000 | 0.49983 | 0.50000 | 1.6832E-4 | 0.75000 |
| 6.1000 | 0.64716 | 0.64695 | -2.1315E-4 | 1.0590 |
| 6.2000 | 0.73782 | 0.73776 | -5.6605E-5 | 1.3378 |
| 6.3000 | 0.73755 | 0.73776 | 2.1070E-4 | 1.5590 |
| 6.4000 | 0.64684 | 0.64695 | 1.0813E-4 | 1.7011 |
| 6.5000 | 0.50017 | 0.50000 | -1.6540E-4 | 1.7500 |
| 6.6000 | 0.35293 | 0.35305 | 1.2049E-4 | 1.7011 |
| 6.7000 | 0.26184 | 0.26224 | 4.0071E-4 | 1.5590 |
| 6.8000 | 0.26237 | 0.26224 | -1.3124E-4 | 1.3378 |
| 6.9000 | 0.35309 | 0.35305 | -3.3175E-5 | 1.0590 |
| 7.0000 | 0.49959 | 0.50000 | 4.1336E-4 | 0.75000 |
| 7.1000 | 0.64710 | 0.64695 | -1.4890E-4 | 0.44098 |
| 7.2000 | 0.73790 | 0.73776 | -1.3296E-4 | 0.16221 |
| 7.3000 | 0.73743 | 0.73776 | 3.3393E-4 | -0.059017 |
| 7.4000 | 0.64709 | 0.64695 | -1.4551E-4 | -0.20106 |
| 7.5000 | 0.50032 | 0.50000 | -3.1910E-4 | -0.25000 |
| 7.6000 | 0.35271 | 0.35305 | 3.4860E-4 | -0.20106 |
| 7.7000 | 0.26215 | 0.26224 | 8.3747E-5 | -0.059017 |
| 7.8000 | 0.26252 | 0.26224 | -2.7998E-4 | 0.16221 |
| 7.9000 | 0.35287 | 0.35305 | 1.8078E-4 | 0.44098 |
| 8.0000 | 0.49982 | 0.50000 | 1.7843E-4 | 0.75000 |
| 8.1000 | 0.64716 | 0.64695 | -2.1569E-4 | 1.0590 |
| 8.2000 | 0.73787 | 0.73776 | -1.0682E-4 | 1.3378 |
| 8.3000 | 0.73762 | 0.73776 | 1.4686E-4 | 1.5590 |
| 8.4000 | 0.64690 | 0.64695 | 5.0948E-5 | 1.7011 |
| 8.5000 | 0.50025 | 0.50000 | -2.4692E-4 | 1.7500 |
| 8.6000 | 0.35304 | 0.35305 | 9.5830E-6 | 1.7011 |
| 8.7000 | 0.26199 | 0.26224 | 2.4400E-4 | 1.5590 |
| 8.8000 | 0.26257 | 0.26224 | -3.3199E-4 | 1.3378 |
| 8.9000 | 0.35326 | 0.35305 | -2.0693E-4 | 1.0590 |
| 9.0000 | 0.49973 | 0.50000 | 2.7399E-4 | 0.75000 |
| 9.1000 | 0.64718 | 0.64695 | -2.3299E-4 | 0.44098 |
| 9.2000 | 0.73798 | 0.73776 | -2.1192E-4 | 0.16221 |
| 9.3000 | 0.73742 | 0.73776 | 3.4887E-4 | -0.059017 |
| 9.4000 | 0.64709 | 0.64695 | -1.4748E-4 | -0.20106 |
| 9.5000 | 0.50026 | 0.50000 | -2.5848E-4 | -0.25000 |
| 9.6000 | 0.35267 | 0.35305 | 3.8584E-4 | -0.20106 |
| 9.7000 | 0.26213 | 0.26224 | 1.0931E-4 | -0.059017 |
| 9.8000 | 0.26253 | 0.26224 | -2.9561E-4 | 0.16221 |
| 9.9000 | 0.35290 | 0.35305 | 1.5195E-4 | 0.44098 |
| 10.000 | 0.49982 | 0.50000 | 1.8224E-4 | 0.75000 |

* 1. Plot Groups
     1. 1D Plot Group 1



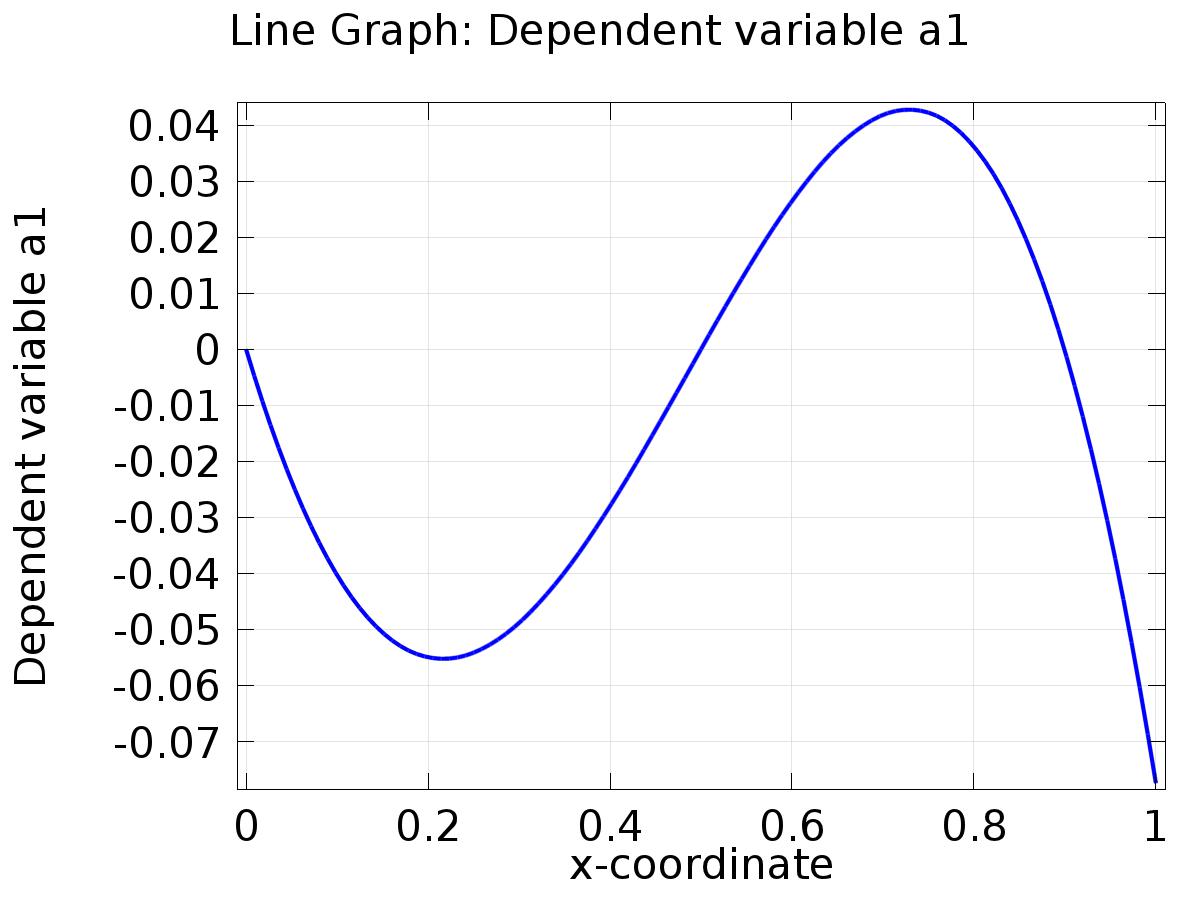
Line Graph: Dependent variable X

* + 1. 1D Plot Group 2



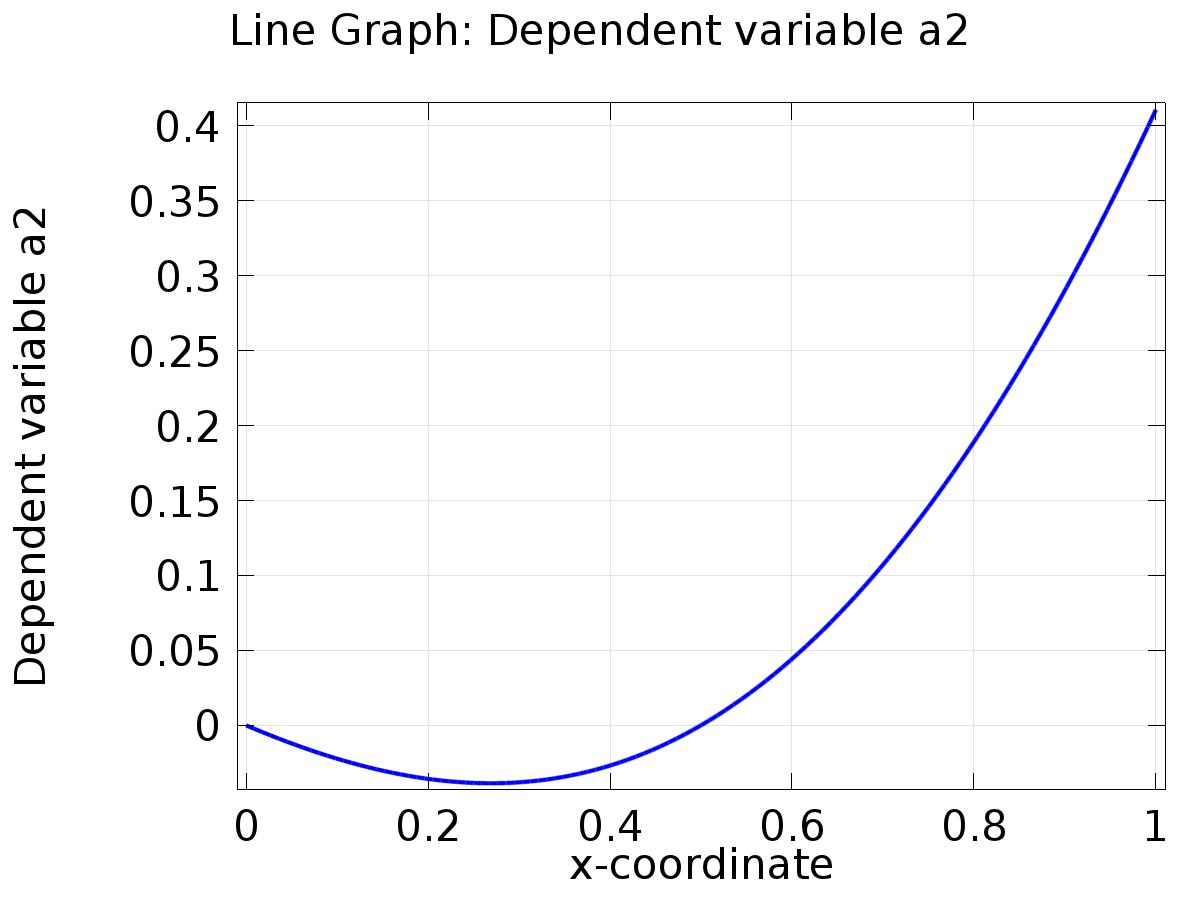
Line Graph: Dependent variable a0

* + 1. 1D Plot Group 3



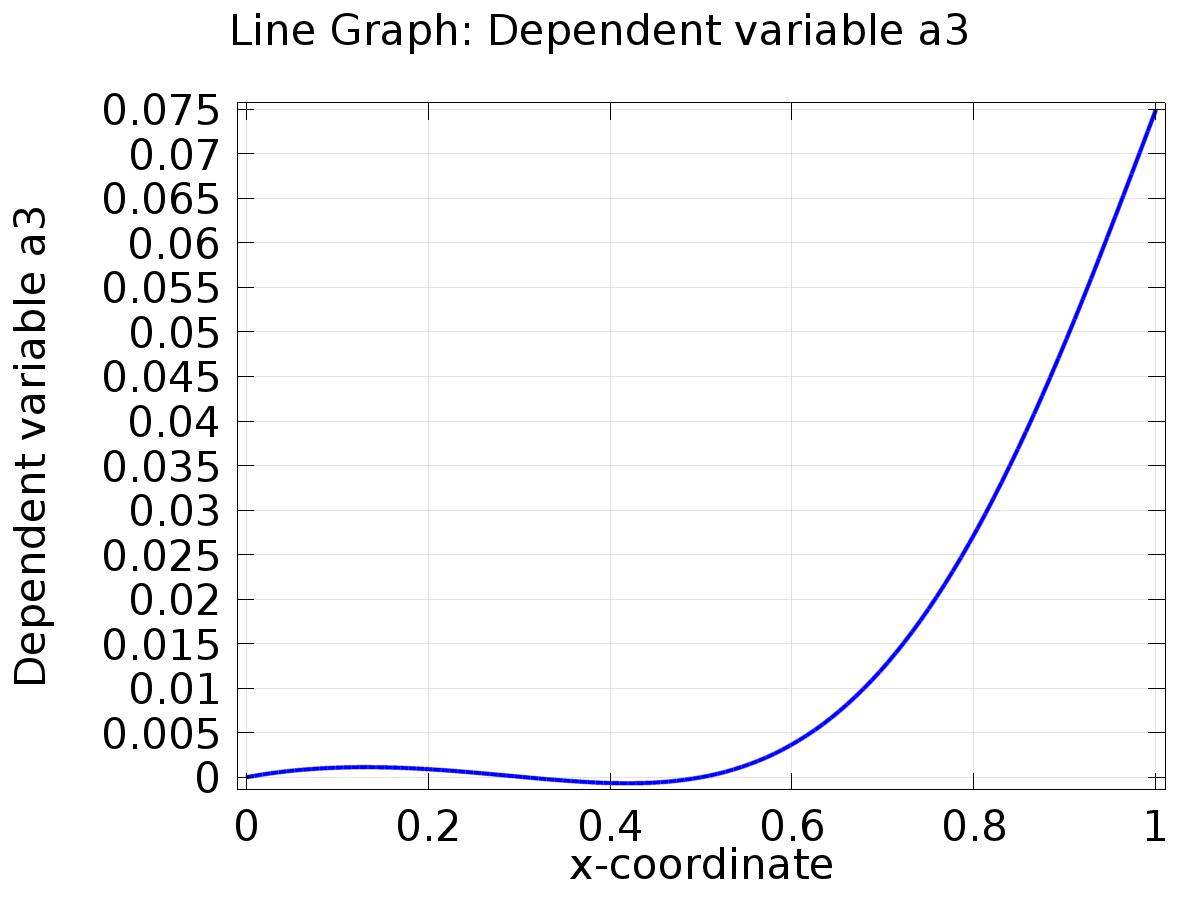
Line Graph: Dependent variable a1

* + 1. 1D Plot Group 4



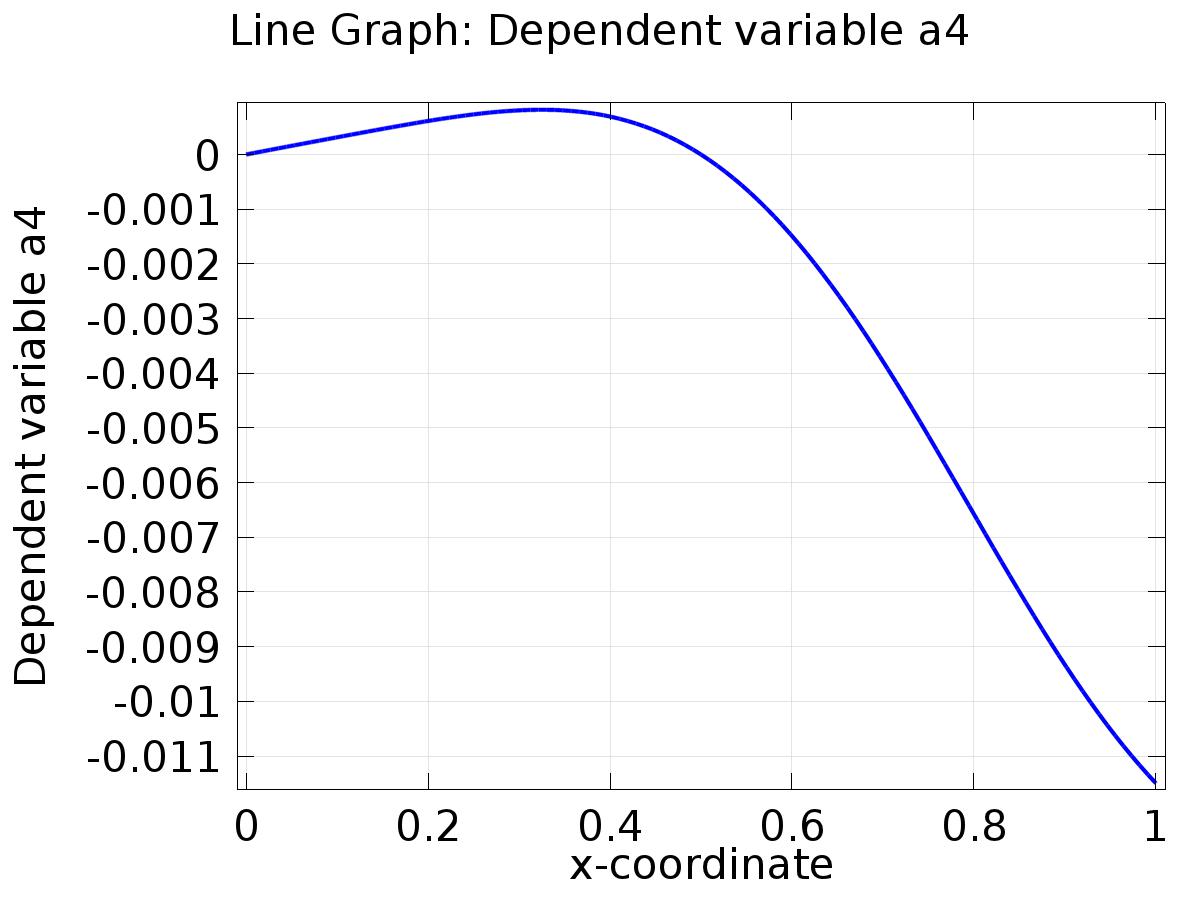
Line Graph: Dependent variable a2

* + 1. 1D Plot Group 5



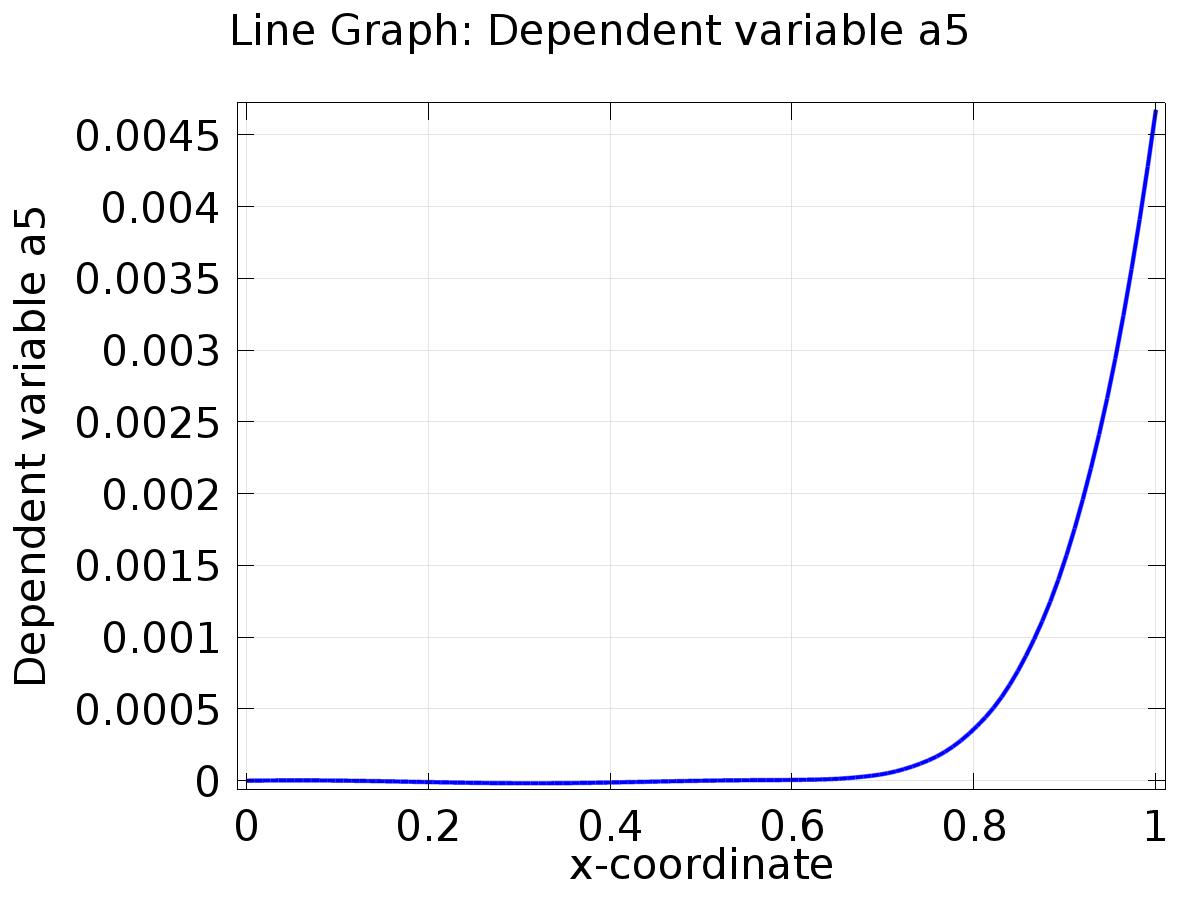
Line Graph: Dependent variable a3

* + 1. 1D Plot Group 6



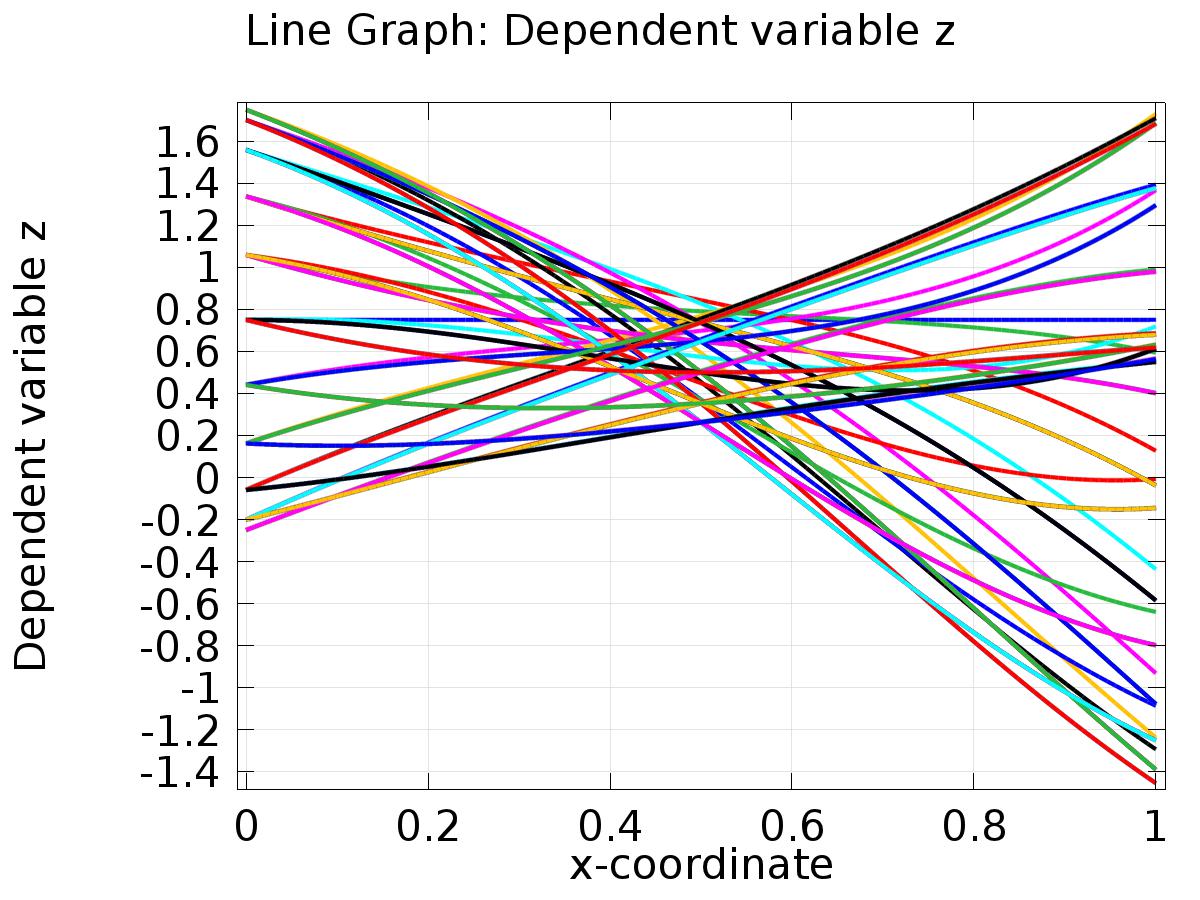
Line Graph: Dependent variable a4

* + 1. 1D Plot Group 7



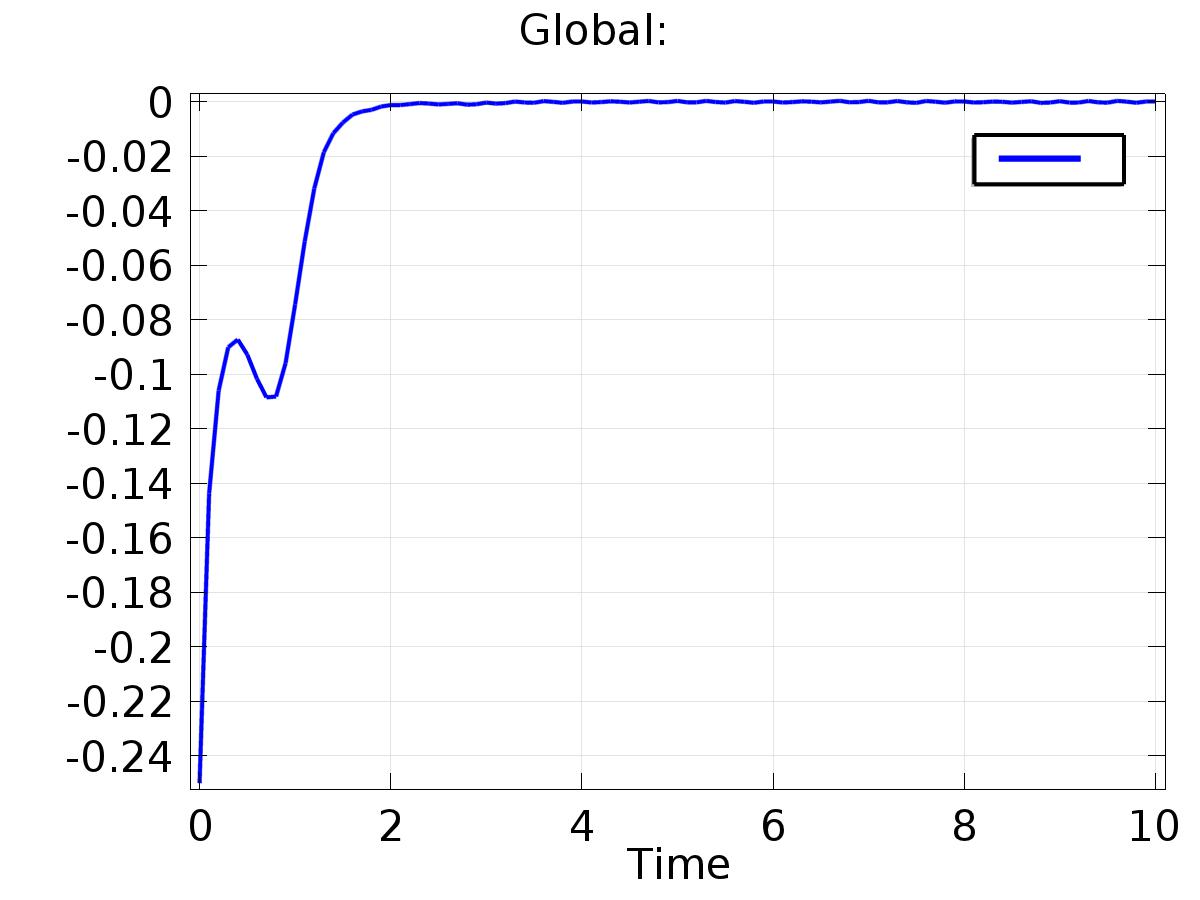
Line Graph: Dependent variable a5

* + 1. 1D Plot Group 8



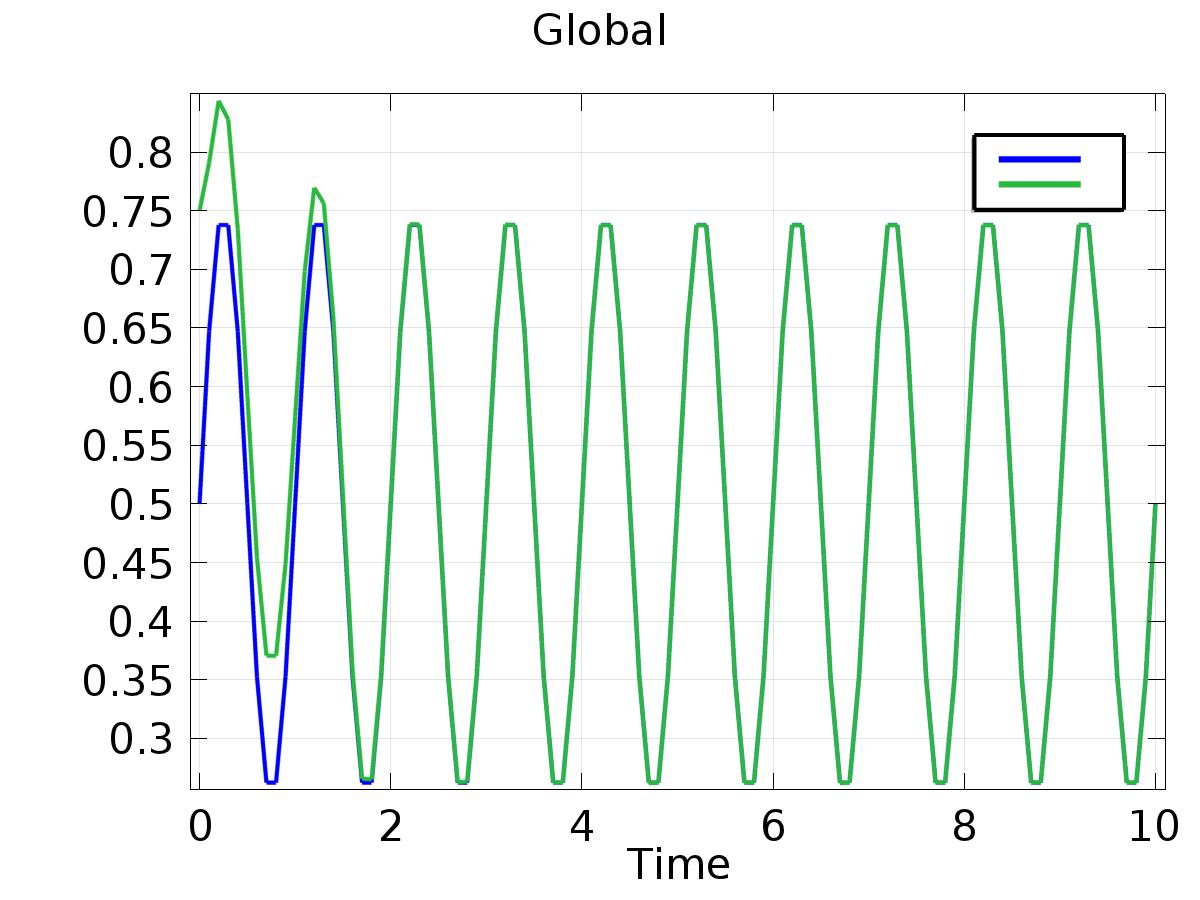
Line Graph: Dependent variable z

* + 1. 1D Plot Group 9



Global:

* + 1. 1D Plot Group 10



Global