Finite Difference Time Domain

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- subroutine updatee ()

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  Hx, Hy TF/SF Updates.
- subroutine tfsf_eupdate ()

  Ez TF/SF Updates.
- real(dp) function source (n)

  Source function for FDTD.

Variables

- integer, parameter, private dp = KIND(1.d0)

  Electric and Magnetic Fields.
- real(dp), dimension(0:sizex-1, 0:sizey-1) **ez** = 0.d0
- real(dp), dimension(0:sizex-2, 0:sizey-1) **hy** = 0.d0
- real(dp), dimension(0:sizex-1, 0:sizey-2) **hx** = 0.d0

2.1.1 Detailed Description

Main FDTD Update Equations.

2.1.2 Function/Subroutine Documentation

2.1.2.1 real(dp) function fdtd::source (integer, intent(in) *n*)

Source function for FDTD.

Parameters

|>p0.15|p0.805|
freq

time

2.1.2.2 subroutine fdtd::tfsf_eupdate ( )

Ez TF/SF Updates.

Parameters

|>p0.15|p0.805|
Ez

HxInc

HyInc

2.1.2.3 subroutine fdtd::tfsf_hupdate ( )

Hx, Hy TF/SF Updates.

Parameters

|>p0.15|p0.805|
Hx

Hy

EzInc

2.1.2.4 subroutine fdtd::updatee ( )

Ez FDTD Update Loop.

Parameters

|>p0.15|p0.805|
Ez

2.1.2.5 subroutine fdtd::updateh ( )

H-field FDTD Update Loops.

Parameters

|>p0.15|p0.805|
Hx field

Hy field

2.1.3 Variable Documentation

2.1.3.1 integer, parameter, private fdtd::dp = KIND(1.d0)

Electric and Magnetic Fields.

Because of the staggering of the Yee grid, the fields are offset from each other. Therefore, Hx(m,n+1/2), Hy(m+1/2,n), and Ez(m,n) share the same index, [m, n].

2.2 fdtd_constants Module Reference

Contains various constants for an FDTD simulation, including sizes of various domains, and electric/magnetic constants.
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Variables

- integer, parameter, private **dp** = KIND(1.d0)
- real(dp), parameter **pi** = 4.0d0 ∗ DATAN(1.0d0)
- real(dp), parameter **cc** = 299792458.d0
- real(dp), parameter **mu0** = 4.0d0 ∗ pi ∗ 10.0d0∗∗(-7.0d0)
- real(dp), parameter **eps0** = 1.0d0 / (cc ∗ cc ∗ mu0)
- real(dp), parameter **freq** = 10.d0∗∗9.d0
- real(dp), parameter **nlambda** = 50
- real(dp), parameter **dx** = (cc / freq) / Nlambda
- real(dp), parameter **dy** = dx
- real(dp), parameter **dt** = dx ∗ 0.99d0 / (DSQRT(2.0d0) ∗ cc)
- integer, parameter **totaltime** = 1000
- integer, parameter **tfsf_size** = 5 ∗ Nlambda
- integer, parameter **pml_size** = 0
- integer, parameter **sizex** = 0.5 ∗ Nlambda + TFSF_Size
- integer, parameter **sizey** = SizeX
- integer, parameter **tfsf_x0** = Nlambda / 4
- integer, parameter **tfsf_x1** = TFSF_x0 + TFSF_Size
- integer, parameter **tfsf_y0** = TFSF_x0
- integer, parameter **tfsf_y1** = TFSF_x1
- real(dp), parameter **phi** = pi / 60.d0
- real(dp), parameter **cosphi** = DCOS(phi)
- real(dp), parameter **sinphi** = DSIN(phi)

2.2.1 Detailed Description

Contains various constants for an FDTD simulation, including sizes of various domains, and electric/magnetic constants.
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dp = FORTRAN constant for double precision floating point on any OS
pi = Standard constant (3.14159...)
cc = The speed of light in m/s
mu0 = magnetic permeability in a vacuum
eps0 = electric permittivity in a vacuum
freq = The highest frequency for the simulation. Used for Fourier Transform when calculating power.
Nlambda = Number of points per wavelength
dx = The spatial step in the x direction
dy = The spatial step in the y direction
dt = The time step increment
TotalTime = The total number of time steps in the simulation
TFSF_Size = The size of the Total Field region, in cells, which must encompass the scatterer
PML_Size = The size, in cells, of the Perfectly Matched Layer, to prevent reflections from boundaries.
SizeX = The size in cells, in the x direction, of the total simulation
SizeY = The size in cells, in the y direction, of the total simualtion
TFSF_x0 = The first cell of the Total Field region in the x direction
TFSF_x1 = The last cell of the Total Field region in the x direction
TFSF_y0 = The first cell of the Total Field region in the y direction
TFSF_y1 = The last cell fo the Total Field region in the y direction
phi = The direction of the plane wave incident on the total field box
cosphi = The cosine of phi
sinphi = The sine of phi

2.3 fieldcoefficients Module Reference

FDTD Coefficients.

Variables

- integer, parameter, private dp = KIND(1.d0)

  A collection of coefficients used in the FDTD update equations.
- real(dp), dimension(0:sizex-1, 0:sizey-1) **ceze** = 1.d0
- real(dp), dimension(0:sizex-1, 0:sizey-1) **cezh** = dt / (eps0 ∗ dx)
- real(dp), dimension(0:sizex-1, 0:sizey-2) **chxh** = 1.d0
- real(dp), dimension(0:sizex-1, 0:sizey-2) **chxe** = dt / (mu0 ∗ dx)
- real(dp), dimension(0:sizex-2, 0:sizey-1) **chyh** = 1.d0
- real(dp), dimension(0:sizex-2, 0:sizey-1) **chye** = dt / (mu0 ∗ dx)

2.3.1 Detailed Description

FDTD Coefficients.

2.3.2 Variable Documentation

2.3.2.1 integer, parameter, private fieldcoefficients::dp = KIND(1.d0)

A collection of coefficients used in the FDTD update equations.

Ceze = Ez: coefficient of previous Ez
Cezh = Ez: coefficient of curl(H)

Chxh = Hx: coefficient of previous Hx
Chxe = Hx: coefficient of curl(E)
Chyh = Hy: coefficient of previous Hy
Chye = Hy: coefficient of curl(E)

2.4 printfield Module Reference

Prints Ez output to a .csv file.

Functions/Subroutines

- subroutine printez ()

  Prints output.

2.4.1 Detailed Description

Prints Ez output to a .csv file.

2.4.2 Function/Subroutine Documentation

2.4.2.1 subroutine printfield::printez ( )

Prints output.

Parameters

>p0.15	p0.805
Ez field

2.5 tfsf Module Reference

Total Field/Scattered Field Implementation.

Functions/Subroutines

- subroutine tfsf_inc ()

  1D TF/SF Update Loops
- subroutine tfsf_updatehinc ()

  Get HxInc and HyInc from Hinc0.
- subroutine tfsf_updateeinc ()

  Update EzInc from Einc0.

Variables

- integer, parameter, private dp = KIND(1.d0)

  Incidenet Fields.
- real(dp), dimension(-10:sizex-1) **einc0**
- real(dp), dimension(-10:sizex-1) **einc1**

- real(dp), dimension(-10:sizex-1) **hinc0**
- real(dp), dimension(-10:sizex-1,-10:sizey-1) **ezinc**
- real(dp), dimension(-10:sizex-1,-10:sizey-1) **hxinc**
- real(dp), dimension(-10:sizex-1,-10:sizey-1) **hyinc**

2.5.1 Detailed Description

Total Field/Scattered Field Implementation.

2.5.2 Function/Subroutine Documentation

2.5.2.1 subroutine tfsf::tfsf_inc ( )

1D TF/SF Update Loops

Parameters

>p0.15	p0.805
Einc0	
Einc1	
Hinc0	

2.5.2.2 subroutine tfsf::tfsf_updateeinc ( )

Update EzInc from Einc0.

Parameters

>p0.15	p0.805
EzInc	
Einc0	

2.5.2.3 subroutine tfsf::tfsf_updatehinc ( )

Get HxInc and HyInc from Hinc0.

Parameters

>p0.15	p0.805
HxInc	
HyInc	
Hinc0	

2.5.3 Variable Documentation

2.5.3.1 integer, parameter, private tfsf::dp = KIND(1.d0)

Incidenet Fields.

The Einc0, Einc1, and Hinc0 fields are the fields on the incident grid.

The EzInc, HxInc, and HyInc fields are used to update the actual FDTD fields.