Package ‘AdvDif4’

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Type Package

Title Solving 1D Advection Bi-Flux Diffusion Equation

Version 0.7.18

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Description This software solves an Advection Bi-Flux Diffusive Problem using the Finite Difference Method FDM. Vasconcellos, J.F.V., Marinho, G.M., Zanni, J.H., 2016, Numerical analysis of an anomalous diffusion with a bimodal flux distribution. <doi:10.1016/j.rimni.2016.05.001>. Silva, L.G., Knupp, D.C., Bevilacqua, L., Galeao, A.C.N.R., Silva Neto, A.J., 2014, Formulation and solution of an Inverse Anomalous Diffusion Problem with Stochastic Techniques. <doi:10.5902/2179460X13184>. In this version, it is possible to include a source as a function depending on space and time, that is, s(x,t).

License GPL-3

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LazyData true

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NeedsCompilation no

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Contents

AdvDif4 *Solving 1D Advection Bi-Flux Diffusion Equation*

Description

This software solves an Advection Bi-Flux Diffusive Problem using the Finite Difference Method FDM. A file with R commands can be consulted in document folder.

Usage

```
AdvDif4(parm,func)
```

Arguments

`parm`	Parameters data. It must contain values for k2,k4,v,l,m,tf,n,w10,w11,w12,w20,w21,w22,e10,e11,e12,e20, needed to run the model.
`func`	Functions definitions. It must contain the functions beta,dbetadp,fn,fs,fw1,fw2,fe1,fe2 needed to run the model.

Value

The resulting matrix with results obtained for each time as rows and at each position as columns.

Examples

```
#
# Begin of the first example
#
# 100th power sinusoidal function as initial condition and no source.
# with advection, bi-blux (primary and secondary diffusion) and constant beta.
#
# Beta function
fbeta <- function(p)
{f <- 0.2
return(f)}
# Beta derivative function
dbetadp <- function(p)
{f <- 0
return(f)}

# Initial condition
fn <- function(x)
{ f <- sin(pi*x)^100
return(f)}

# velocity
v <- 0.2

# Source function
```

```
fs <- function(x,t)
{ f <- 0
 return(f)}

# diffusion coefficients parameter
k2 <- 1e-3
k4 <- 1e-5

# Space and temporal definition
l <- 1
m <- 100
tf <- 1
n <- 1000

# Left boundary conditions
w10 <- 1
w11 <- 0
w12 <- 0
w20 <- 0
w21 <- 1
w22 <- 0
fw1 <- function(t)
{ f <- 0
 return(f)}
fw2 <- function(t)
{ f <- 0
 return(f)}

# Right boundary conditions
e10 <- 1
e11 <- 0
e12 <- 0
e20 <- 0
e21 <- 1
e22 <- 0
fe1 <- function(t)
{ f <- 0
 return(f)}
fe2 <- function(t)
{ f <- 0
 return(f)}
#
parm <- c(k2,k4,v,l,m,tf,n,w10,w11,w12,w20,w21,w22,e10,e11,e12,e20,e21,e22)
func <- c(fbeta=fbeta,dbetadp=dbetadp,fn=fn,fs=fs,fw1=fw1,fw2=fw2,fe1=fe1,fe2=fe2)
#
ad <- AdvDif4(parm,func)
eixo <- seq(0,1,by=0.01)
plot(eixo,ad[1,1:101],type='l',col="red",xaxt="n",xlab="X", ylab="p(x,t)")
axis(1,seq(0,1,0.1),las=2)
lines(eixo,ad[250,1:101],type='l',col="orange")
lines(eixo,ad[500,1:101],type='l',col="green")
lines(eixo,ad[750,1:101],type='l',col="blue")
lines(eixo,ad[1000,1:101],type='l',col="black")
```

```
#
#
# End of the first example
#
#
# Begin of the second example
# 100th power sinusoidal function as initial condition and no source.
# with advection, bi-blux (primary and secondary diffusion) and sigmoid function beta.
#
# Beta function
fbeta <- function(p)
{betamin <- 0.2
betamax <- 1
gama <- 2500
pin <- 0.001
f <- betamax-(betamax-betamin)/(1+exp(-gama*(p-pin)))
return(f)}
# Beta derivative function
dbetadp <- function(p)
{betamin <- 0.2
betamax <- 1
gama <- 2500
pin <- 0.001
f <- (-gama*(betamax-betamin)*exp(-gama*(p-pin))/((1+exp(-gama*(p-pin)))^2))
return(f)}

# Initial condition
fn <- function(x)
{ f <- sin(pi*x)^100
return(f)}

# velocity
v <- 0.2

# Source function
fs <- function(x,t)
{ f <- 0
 return(f)}

# diffusion coefficients parameter
k2 <- 1e-3
k4 <- 1e-5

# Space and temporal definition
l <- 1
m <- 100
tf <- 1
n <- 1000

# Left boundary conditions
w10 <- 1
w11 <- 0
w12 <- 0
```

```
w20 <- 0
w21 <- 1
w22 <- 0
fw1 <- function(t)
{ f <- 0
 return(f)}
fw2 <- function(t)
{ f <- 0
 return(f)}

# Right boundary conditions
e10 <- 1
e11 <- 0
e12 <- 0
e20 <- 0
e21 <- 1
e22 <- 0
fe1 <- function(t)
{ f <- 0
 return(f)}
fe2 <- function(t)
{ f <- 0
 return(f)}
#
parm <- c(k2,k4,v,l,m,tf,n,w10,w11,w12,w20,w21,w22,e10,e11,e12,e20,e21,e22)
func <- c(fbeta=fbeta,dbetadp=dbetadp,fn=fn,fs=fs,fw1=fw1,fw2=fw2,fe1=fe1,fe2=fe2)
#
ad <- AdvDif4(parm,func)
eixo <- seq(0,1,by=0.01)
plot(eixo,ad[1,1:101],type='l',col="red",xaxt="n",xlab="X", ylab="p(x,t)")
axis(1,seq(0,1,0.1),las=2)
lines(eixo,ad[250,1:101],type='l',col="orange")
lines(eixo,ad[500,1:101],type='l',col="green")
lines(eixo,ad[750,1:101],type='l',col="blue")
lines(eixo,ad[1000,1:101],type='l',col="black")
#
# End of the second example
#
#
# Begin of the third example
# zero initial condition and a source.
# with advection, bi-blux (primary and secondary diffusion) and constant beta.
#
# Beta function
fbeta <- function(p)
{f <- 0.2
return(f)}
# Beta derivative function
dbetadp <- function(p)
{f <- 0
return(f)}

# Initial condition
```

```
fn <- function(x)
{ f <- 0
return(f)}

# velocity
v <- 0.00

# Source function
fs <- function(x,t)
{ if(x<=0.1){f <- 1}
 else{f <- 0}
return(f)}

# diffusion coefficients parameter
k2 <- 1e-3
k4 <- 1e-5

# Space and temporal definition
l <- 1
m <- 100
tf <- 1
n <- 1000

# Left boundary conditions
w10 <- 0
w11 <- 1
w12 <- 0
w20 <- 0
w21 <- 0
w22 <- 1
fw1 <- function(t)
{ f <- 0
 return(f)}
fw2 <- function(t)
{ f <- 0
 return(f)}

# Right boundary conditions
e10 <- 0
e11 <- 1
e12 <- 0
e20 <- 0
e21 <- 0
e22 <- 1
fe1 <- function(t)
{ f <- 0
 return(f)}
fe2 <- function(t)
{ f <- 0
 return(f)}
#
parm <- c(k2,k4,v,l,m,tf,n,w10,w11,w12,w20,w21,w22,e10,e11,e12,e20,e21,e22)
func <- c(fbeta=fbeta,dbetadp=dbetadp,fn=fn,fs=fs,fw1=fw1,fw2=fw2,fe1=fe1,fe2=fe2)
```

```
#
ad <- AdvDif4(parm,func)
eixo <- seq(0,1,by=0.01)
plot(eixo,ad[1000,1:101],type='l',col="black",xaxt="n",xlab="X", ylab="p(x,t)")
axis(1,seq(0,1,0.1),las=2)
lines(eixo,ad[250,1:101],type='l',col="orange")
lines(eixo,ad[500,1:101],type='l',col="green")
lines(eixo,ad[750,1:101],type='l',col="blue")
lines(eixo,ad[1,1:101],type='l',col="red")
#
# End of the third example
#
# It is easy to change k4 value in the previous example to observe its effect.
# Another possibility is to change beta function and its derivative also.
# There are more examples and also "News.md" inside "doc"" folder.
#
#
```

pentaSolve *Solving 'Ax=b' system*

Description

This software solves an 'Ax=b' pentadiagonal system using a direct method. Variables a1, a2, a3, a4, a5 are matrix A diags and b is the vector.

Usage

```
pentaSolve(a1,a2,a3,a4,a5,b)
```

Arguments

a1	A vector
a2	A vector
a3	A vector
a4	A vector
a5	A vector
b	A vector

Value

A vector with the x value

Examples

```
#
# Solve a 'Ax=b' easy sample
#
a1<-c(1)
a2<-c(2,2)
a3<-c(7,7,7)
a4<-c(2,2)
a5<-c(1)
b<-c(11,12,13)
pentaSolve(a1,a2,a3,a4,a5,b)
```

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