if (FIT==0){

Modelhole=function(fitlag,C0\_constant\_cosinus,C1\_T,C2\_constant\_GRW,C3\_GRW)

{C0\_constant\_cosinus\*(1-cos(2\*pi\*averagetime\*fitlag/C1\_T))+

2\*C2\_constant\_GRW\*(1-C3\_GRW^fitlag)/(1-C3\_GRW^2)}

#in case of damped cosine

#/(6.28\*fitlag/C2))

maxvar=max(fitvariogram)

#0.5 range covered by periodic function on Variogram axis

fraction\_period=0.5

# Upper and lower boundaries for the periodic function

C0l=fraction\_period\*maxvar/5

C0m=C0l\*5

#period=2\*averagetime\*fitlag[which.max(fitvariogram)]

period=150

int=100

# series 1

if(T){

if(film=="film20"|film=="film18"|film=="film21"){

period=150

int=30

}

if(film=="film1"|film=="film19"){

period=80

int=40

}

if(film=="film14"){

period=40

int=20

}

}

# series 2

if(F){

if(film=="film17"){

period=50

int=25

}

}

# series 3

if(F){

if(film=="film20"|film=="film18"){

period=80

int=20

}

}

# Lehigh\_data

if(F){

if(film=="Lehigh\_data"|film=="Lehigh\_data\_VolatilityClustering"){

period=20

int=10

}

}

# series 4

if(F){

if(film=="run1-Curo"){

#C0l=0.00005

#C0m=0.00005

period=250

int=25

C3l=0.97

C3m=0.97

#C2l=0.00002

#C2m=0.00002

}

if(film=="run2-Curo+silica"){

#C0l=0.00001

#C0m=0.00001

period=400

int=100

C3l=0.95

C3m=0.95

#C2l=0.00002

#C2m=0.00002

}

if(film=="run3-Curo+alumina"){

period=150

int=50

C3l=0.479

C3m=0.479

}

}

# upper and lower boundaries

C1l=period-int

C1m=period+int

C2l=0.1\*C0l # reference is the amplitude of the periodic function C0m and C0l

C2m=C0m

C3l=0.3

C3m=1.0

# constants C2 and C3 are fixed (for the master curve)

# C3l=C3m is alfa in GRW is fixed to 0.658;

# C2l=C2l is sigma^2 in GRW

# to explore the effect of one single parameter value for all frequencies

if(F){

C2l=0.036

C2m=C2l

C3l=0.658

C3m=C3l

}

# start values based on the average of upper and lower boundaries for the fitpara,eter intervals

C0s=(C0l+C0m)/2

C1s=(C1l+C1m)/2

C2s=(C2l+C2m)/2

C3s=(C3l+C3m)/2

variogramfit=nlsLM(fitvariogram~Modelhole(fitlag,C0\_constant\_cosinus,C1\_T,C2\_constant\_GRW,C3\_GRW),

start=list(C0\_constant\_cosinus=C0s,C1\_T=C1s,C2\_constant\_GRW=C2s,C3\_GRW=C3s),

lower=c(C0l,C1l,C2l,C3l),

#upper=c(C0l,C1l,C2l,C3l))

upper=c(C0m,C1m,C2m,C3m))

# C0 amplitude C1 period C2 alfa C3 sigma^2

C0\_constant\_cosinus =coef(variogramfit)[1]

C1\_T =coef(variogramfit)[2]

C2\_constant\_GRW =coef(variogramfit)[3]

C3\_GRW =coef(variogramfit)[4]

#lines(lwd=lwd,predict(variogramfit),col='red')

x=(10:(10\*length(fitlag)))/10

lines(lwd=lwd,predict(variogramfit,list(x)),col='red')

lines(lwd=lwd,x,2\*C2\_constant\_GRW\*(1-C3\_GRW^x)/(1-C3\_GRW^2),col="blue")

mtext(cex=0.75,paste0("T(s)=",round(C1\_T,1)," alfa=",round(C3\_GRW,3)," sigma^2=",round(C2\_constant\_GRW,3)),3,pos\_line)

# plot for publication

if(film=="film15" | film=="film10" | film=="film21"){

#if(film=="film12" | film=="film13" | film=="film17"){

GRW=2\*C2\_constant\_GRW\*(1-C3\_GRW^fitlag)/(1-C3\_GRW^2)

Periodic\_plus\_GRW=predict(variogramfit,list(fitlag))

plot\_fit=data.frame(fitlag,fitvariogram,Periodic\_plus\_GRW,GRW)

file=paste(film,"plot\_fit\_variogram\_GRW.txt",sep="")

setwd("/Users/macbookair/Desktop/Series/Plots4Pub/DataAnalysisMethod/")

write.table(format(plot\_fit,digits=3),file=file,na="",quote=FALSE,sep=" ",col.names=TRUE,row.names=FALSE)

}

}

#(damped) cosinus with Ornstein-Uhlenbeck contribution (Mean Reverting Mechanism)

if (FIT==1){

Modelhole=function(fitlag,C0\_constant\_cosinus,C1\_T,C2\_constant\_OU,C3\_correlationtime)

{C0\_constant\_cosinus\*(1-cos(2\*pi\*averagetime\*fitlag/C1\_T))+

C2\_constant\_OU\*(C3\_correlationtime/averagetime)\*(1-exp(-fitlag\*averagetime/C3\_correlationtime))}

#in case of damped cosine

#/(6.28\*fitlag/C2))

maxvar=max(fitvariogram)

#0.5 range covered by periodic function on Variogram axis

fraction\_period=0.5

C0l=fraction\_period\*maxvar/5

C0m=C0l\*5

#C1=6.28/estimated period = 100 lags > 0.0628

#period=2\*fitlag[which.max(fitvariogram)]

#period=2\*averagetime\*fitlag[which.max(fitvariogram)]

period=150

int=10

# series 1

if(TRUE){

if(film=="film20"|film=="film18"|film=="film21"){

period=120

int=30

}

if(film=="film1"|film=="film19"){

period=80

int=40

}

if(film=="film14"){

period=40

int=20

}

}

# series 2

if(F){

if(film=="film17"){

period=50

int=25

}

}

# series 3

if(F){

if(film=="film20"|film=="film18"){

period=80

int=20

}

}

if(F){

# Lehigh\_data

if(film=="Lehigh\_data"|film=="Lehigh\_data\_VolatilityClustering"){

period=20

int=10

}

}

# series 4

if(F){

if(film=="run1-Curo"){

#C0l=0.00005

#C0m=0.00005

period=250

int=25

C3l=22

C3m=22

#C2l=0.00002

#C2m=0.00002

}

if(film=="run2-Curo+silica"){

#C0l=0.00001

#C0m=0.00001

period=400

int=100

C3l=22

C3m=22

#C2l=0.00002

#C2m=0.00002

}

if(film=="run3-Curo+alumina"){

period=150

int=50

C3l=0.68

C3m=0.68

}

}

C1l=period-int

C1m=period+int

C2l=0.1\*C0l

C2m=C0m

C3l=0.1

C3m=15

#

# do not remember where this is coming from: (C3l=0.01; C3m=0.5\*fitlag[which.max(fitvariogram)]; C3m=5\*averagetime)

#

# constants C2 and C3 are fixed (for the master curve)

# C3l=C3m is correlation time is fixed to 2.386

# C2l=C2l is related to sigma^2 in OU model

# to explore the effect of one single parameter value for all frequencies

if(F){

C2l=0.058

C2m=C2l

C3l=2.386

C3m=C3l

}

#

C0s=(C0l+C0m)/2

C1s=(C1l+C1m)/2

C2s=(C2l+C2m)/2

C3s=(C3l+C3m)/2

variogramfit=nlsLM(fitvariogram~Modelhole(fitlag,C0\_constant\_cosinus,C1\_T,C2\_constant\_OU,C3\_correlationtime),

start=list(C0\_constant\_cosinus=C0s,C1\_T=C1s,C2\_constant\_OU=C2s,C3\_correlationtime=C3s),

lower=c(C0l,C1l,C2l,C3l),

#upper=c(C0l,C1l,C2l,C3l))

upper=c(C0m,C1m,C2m,C3m))

# C0 amplitude C1 period C2 UO prefactor sigma^2 C3 1/relaxation lag

C0\_constant\_cosinus =coef(variogramfit)[1]

C1\_T =coef(variogramfit)[2]

C2\_constant\_OU =coef(variogramfit)[3]

C3\_correlationtime =coef(variogramfit)[4]

#lines(lwd=lwd,predict(variogramfit),col='red')

x=(10:(10\*length(fitlag)))/10

lines(lwd=lwd,predict(variogramfit,list(x)),col='red')

lines(lwd=lwd,x,C2\_constant\_OU\*(C3\_correlationtime/averagetime)\*(1-exp(-x\*averagetime/C3\_correlationtime)),col="blue")

mtext(cex=0.75,paste0("T(s)=",round(C1\_T,1)," tau(s)=",round(C3\_correlationtime,3)," sigma^2=",round(C2\_constant\_OU,3)),3,pos\_line)

# plot for publication - dending on the series

if(film=="film15" | film=="film10" | film=="film21"){

#if(film=="film12" | film=="film13" | film=="film17"){

OUP=C2\_constant\_OU\*(C3\_correlationtime/averagetime)\*(1-exp(-fitlag\*averagetime/C3\_correlationtime))

Periodic\_plus\_OUP=predict(variogramfit,list(fitlag))

plot\_fit=data.frame(fitlag,fitvariogram,Periodic\_plus\_OUP,OUP)

file=paste(film,"plot\_fit\_variogram\_OUP.txt",sep="")

setwd("/Users/macbookair/Desktop/Series/Plots4Pub/DataAnalysisMethod/")

write.table(format(plot\_fit,digits=3),file=file,quote=FALSE,na="",sep=" ",col.names=TRUE,row.names=FALSE)

}

}