ROpenTURNS

toward the [R] User Interface

Y. Richet & R. François

[R] User Interface

Why ?

- spread OT in R community
- spread R (tech.) in OT community
- see if we get there ...

[R] User Interface

How ?

- Mimic the TUI
- ... known environment for R users
- ... add R features for OT users

[R] User Interface

What ?

- A proof of concept
  - based on Rcpp
  - compatible with OT 1.0
  - for now, covers only some OT features

[R] User Interface

What ?

- A proof of concept
  - based on Rcpp
  - compatible with OT 1.0
  - for now, covers only some OT features
- Freely available
  - GPL
  - on demand now: yann.richet@irsn.fr
  - on CRAN soon: `R> install.packages('ROpenTURNS')`
  - Windows version to be studied

Things you can do from RUI

- Merge OpenTURNS & R scripts
- Call a remote simulation with Promethee
- Benefits from R technologies
- ...
- Mash-up everything you wish

Merge OpenTURNS & R scripts

Features in OT, missing in R

- FunctionalChaos
- FORM/SORM
- ...

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- FunctionalChaos
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Features in R, missing in OT

- kriging
- neural networks
- optimization/inversion
- JAGS/BUGS coupling
- ...

Call a remote simulation with Promethee (IRSN)

- Grid/Cloud computing dispatcher (Java)
- Designed for Computer Experiments
- Coupled with ~20 simulators (neutronics, shielding, T-H, CFD, flooding, ...)
- Simulator input file template:

```
Godiva critical reactor and kcode example

 1    1  -18.74  -1  imp:n=1   $ enriched uranium sphere (godiva)
 2    0           1  imp:n=0   $ all space outside the sphere

 1    so 8.741                 $ radius of the godiva sphere

 kcode 1000 1.0 10 1010        $ kcode defines a criticality calculation
 ksrc  0 0 0                   $ initial keff spatial dist is point at origin
 m1    92235 -93.71  92238 -5.27  92234 -1.02  $ define u with weight fractions
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```
Promethee.run(model = "MCNP_5",input.files = "godiva",input.design = data.frame(r=1:10))$keffecti
```

```
[1] 0.11860 0.23928 0.36149 0.48200 0.59928 0.71293 0.82090 0.92365 1.02042
[10] 1.11112
```

Mashup: propagate MCNP uncertainties on Uranium composition

```
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m1    92235 -%(u5~93.71)  92238 -%(u8~5.27)  92234 -@{100.-%u5-%u8|1.02}  $ define u with weight f
```

Mashup: propagate MCNP uncertainties on Uranium composition

```
library( ROpenTurns )

RS <- new( CorrelationMatrix, 2 )
RS$set( 1, 0, .5 )
as( RS, "matrix" )

mat <- NormalCopula.GetCorrelationFromSpearmanCorrelation( RS )
copuleNormal <- new( NormalCopula, mat )

distributionU5 <- new( LogNormal, 93.71, 0.1, 0, LogNormal.MUSIGMA )
distributionU8 <- new( LogNormal, 5.27, 0.1, 0, LogNormal.MUSIGMA )

copule <- new( Copula, copuleNormal )

inputDistribution <- new( ComposedDistribution, list(u5=distributionU5, u8=distributionU8), copule
inputRandomVector <- new( RandomVector, inputDistribution )
```

Mashup: propagate MCNP uncertainties on Uranium composition

```
source("/opt/promethee1.3-0/promethee.R")
Promethee.init(PROMETHEE_HOME="/opt/promethee1.3-0/")
fun <- function(x){
  Promethee.run(model = "MCNP_5",input.files = "godiva.p",input.design = data.frame(u5=x[1],u8=x[2]
    archive.dir="/tmp/godiva.p.dir",cache.dir="/tmp/godiva.p.dir")$mean_keff
}
fun_OT <- asNumericalMathFunction( fun, 2, 1 )
```

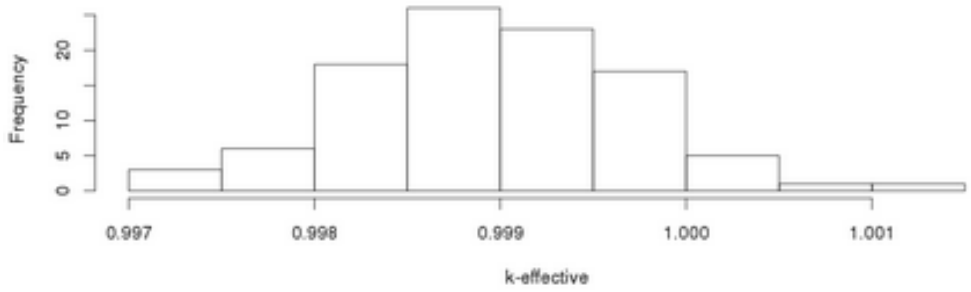
```
outputVariableOfInterest <- new( RandomVector, fun_OT, inputRandomVector )

output_sample <- outputVariableOfInterest$getNumericalSample( 100 )
outputMean <- output_sample$computeMean()
outputCovariance <- output_sample$computeCovariance()
```

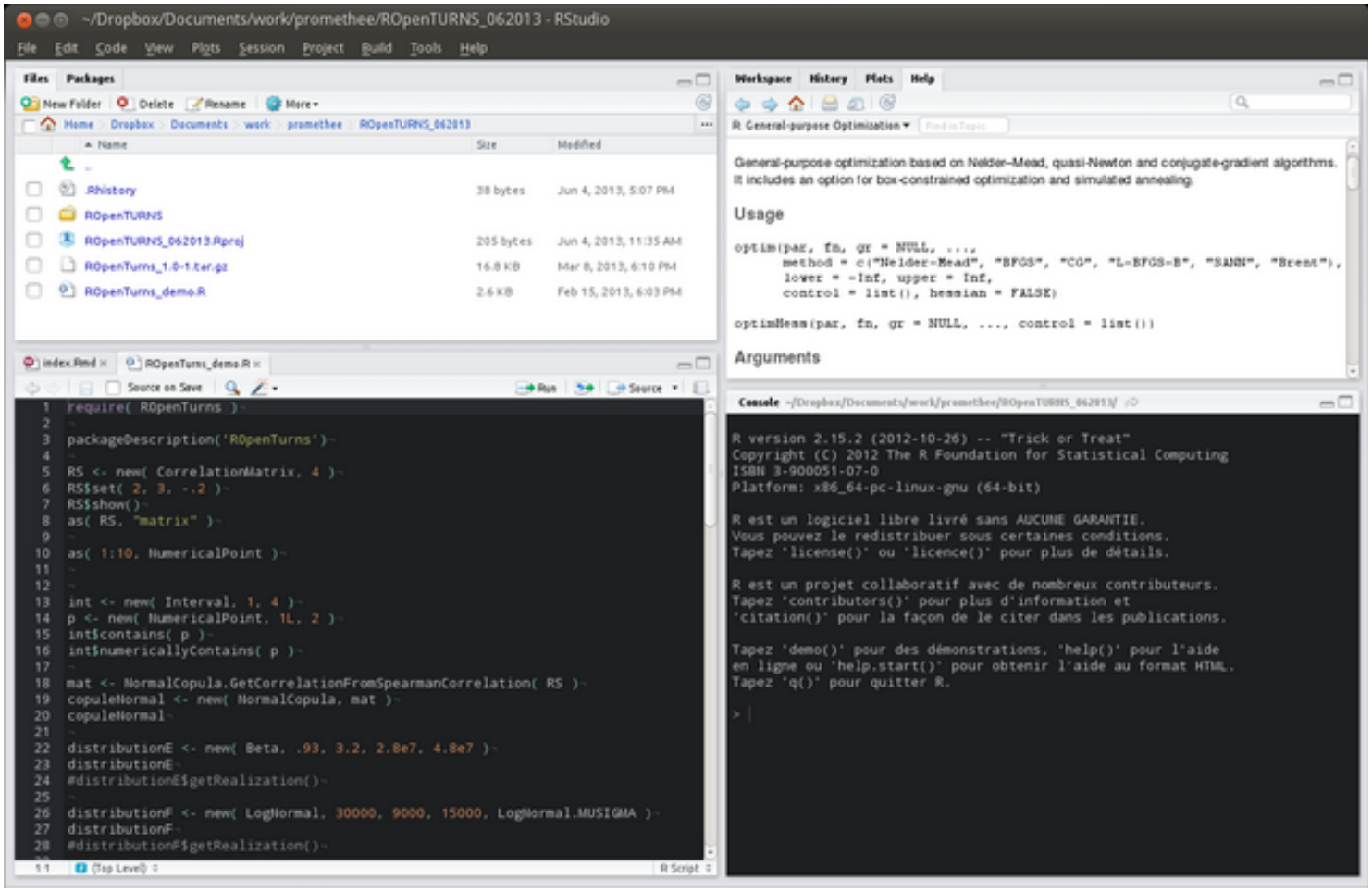
Mashup: propagate MCNP uncertainties on Uranium composition

```
> outputMean
class=NumericalPoint name=Unnamed dimension=1 values=[0.998952]
> outputCovariance
class=CovarianceMatrix dimension=1 implementation=class=MatrixImplementation
name=Unnamed rows=1 columns=1 values=[5.64849e-07]

 hist(as(output_sample,"matrix"),xlab="k-effective",main="")
```



Benefits from R tech. - RStudio

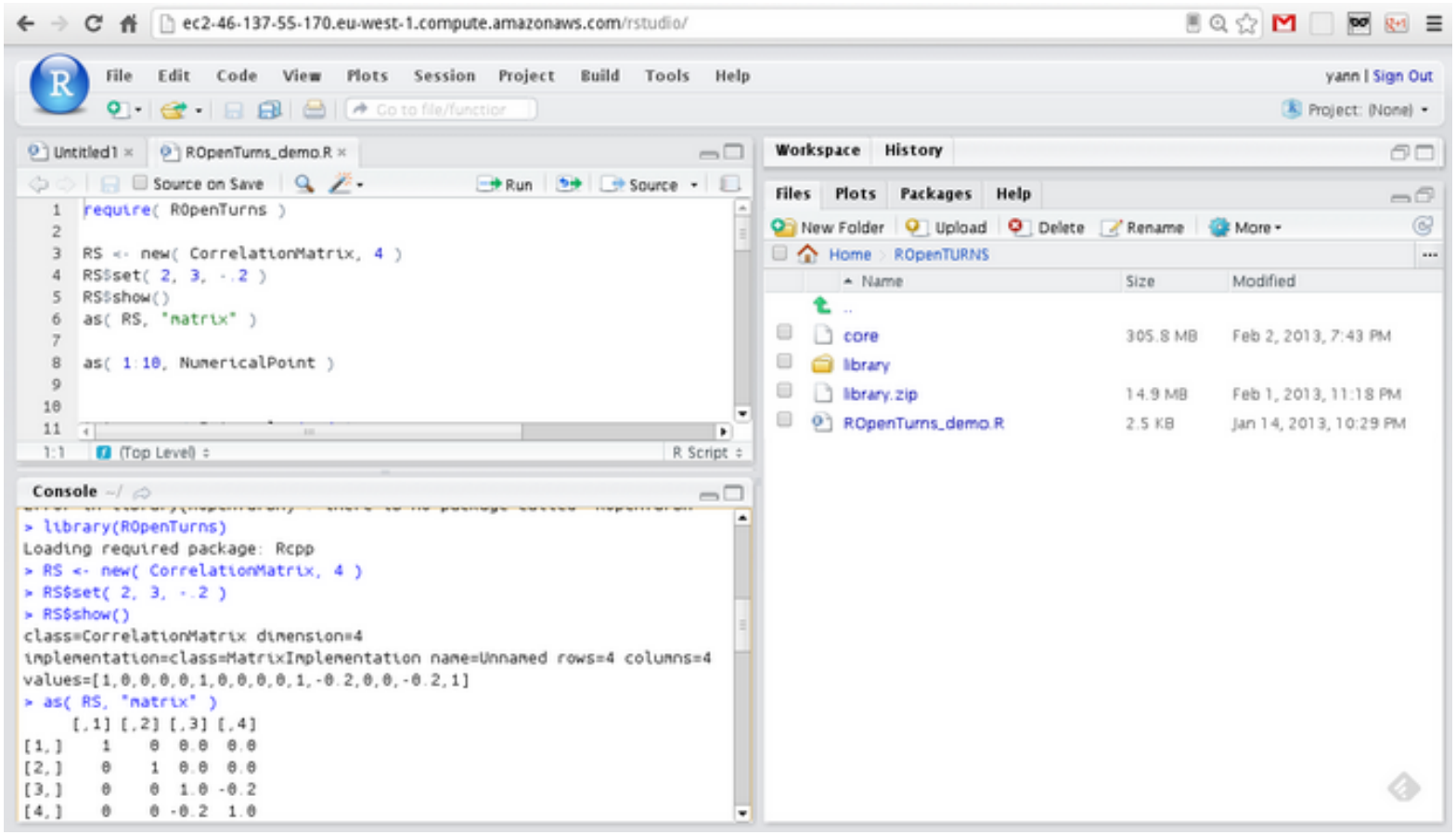


Benefits from R tech. - RStudio

- Powerfull script editor
  - R, C/C++, TeX, markdown, ...
  - project management
  - version control: git/svn, diff
- Shell environment
  - interactive shell
  - workspace view
  - functions help
  - plots

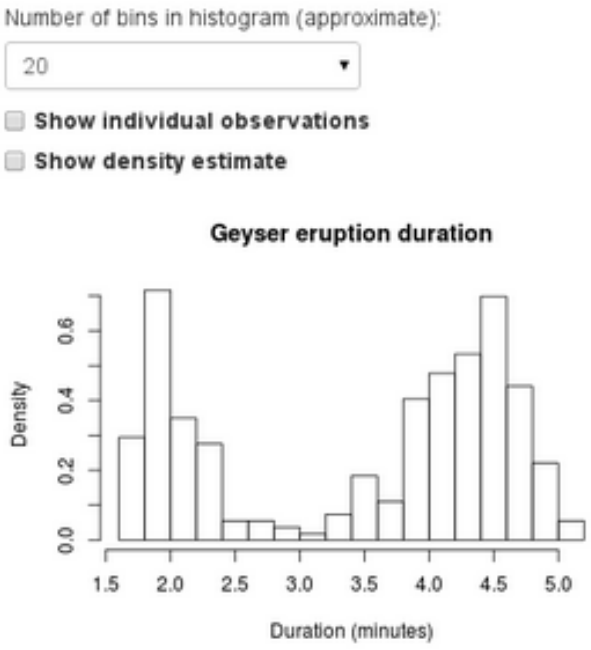
Benefits from R tech. - RStudio

- **Full featured online version**:



Benefits from R tech. - Shiny

- Interactive web app. in R(-OT) without HTML/js
- May include any R package (ROpenTURNS)
- Easy (reactive) programming:



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ui.R

```
shinyUI(bootstrapPage(

  selectInput(inputId = "n_breaks",
      label = "Number of bins in histogram (approximate):",
      choices = c(10, 20, 35, 50),
      selected = 20),

  checkboxInput(inputId = "individual_obs",
      label = strong("Show individual observations"),
      value = FALSE),

  checkboxInput(inputId = "density",
      label = strong("Show density estimate"),
      value = FALSE),

  plotOutput(outputId = "main_plot", height = "300px"),

  # Display this only if the density is shown
  conditionalPanel(condition = "input.density == true",
    sliderInput(inputId = "bw_adjust",
        label = "Bandwidth adjustment:",
        min = 0.2, max = 2, value = 1, step = 0.2)
  )

))
```

server.R

```
shinyServer(function(input, output) {

  output$main_plot <- renderPlot({

    hist(faithful$eruptions,
      probability = TRUE,
      breaks = as.numeric(input$n_breaks),
      xlab = "Duration (minutes)",
      main = "Geyser eruption duration")

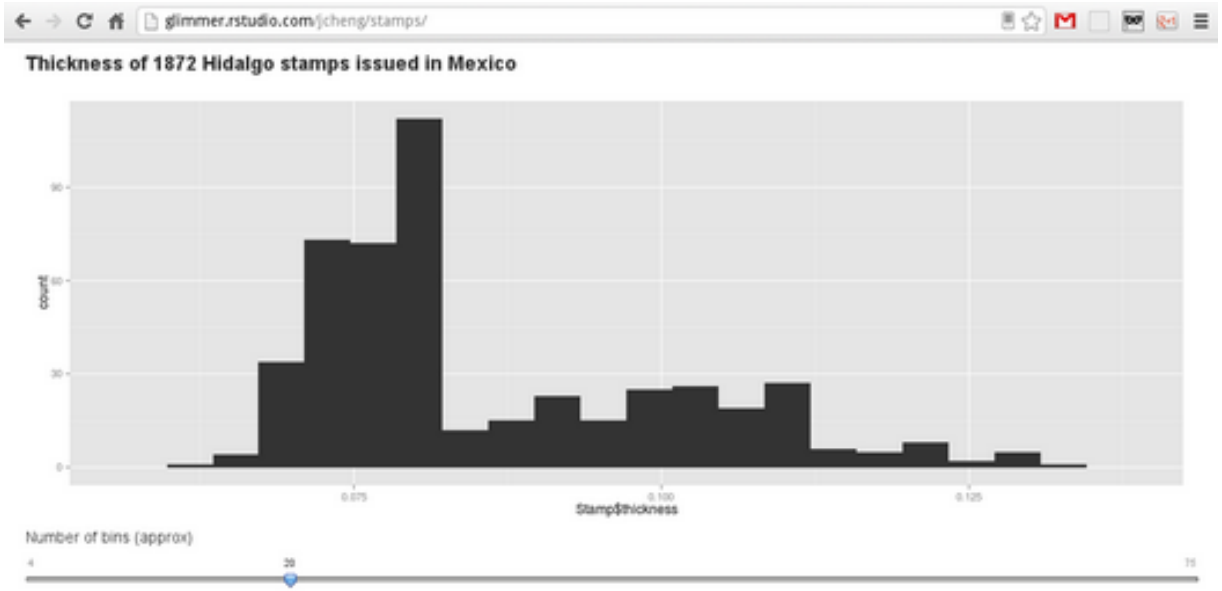
    if (input$individual_obs) {
      rug(faithful$eruptions)
    }

    if (input$density) {
      dens <- density(faithful$eruptions,
          adjust = input$bw_adjust)
      lines(dens, col = "blue")
    }

  })
})
```

Benefits from R tech. - Shiny

- Examples :
  - http://glimmer.rstudio.com/jcheng/stamps/



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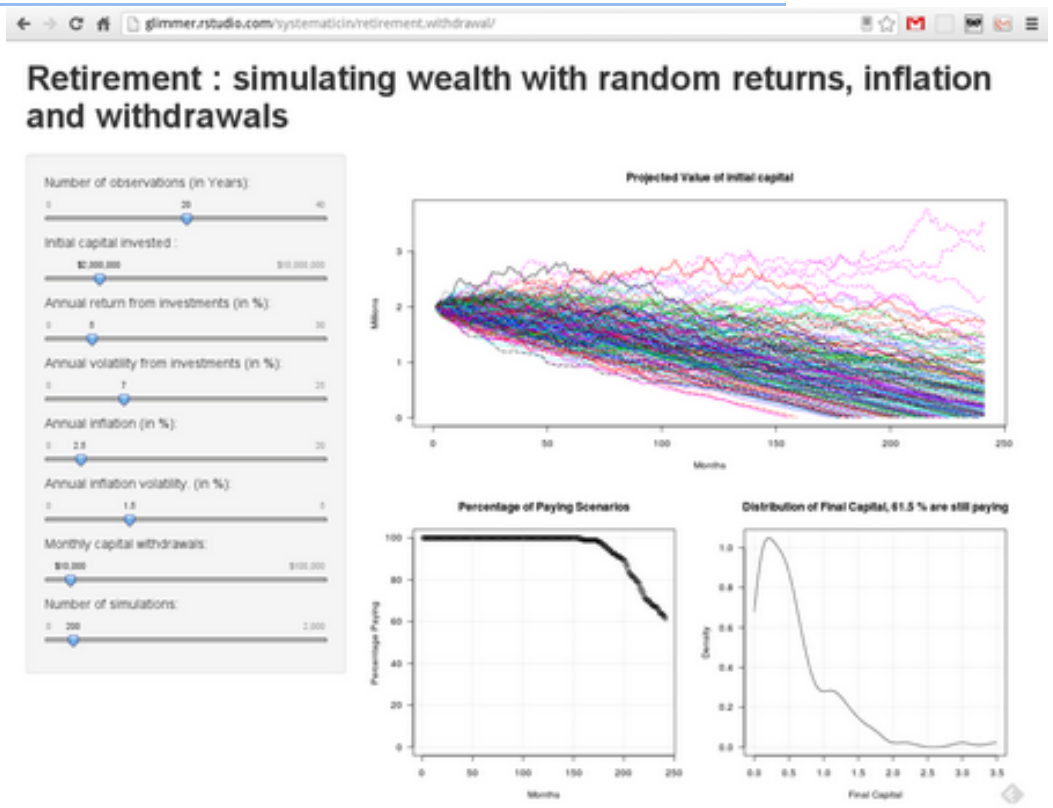
  - http://glimmer.rstudio.com/systematicin/retirement.withdrawal/



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