River Computations in R (rcr-package) Demonstration

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May 2019

rcr Demonstration

A demonstration of the **rcr** package using the built-in sample data is provided.

Read in the sample package cross-section data.

```
library(rcr)

# read in geometry for two sections
df <- rcr::topo_sections
dd_4 <- df[df$xsection == 4,]
dd_5 <- df[df$xsection == 5,]
dd_6 <- df[df$xsection == 6,]
```

Setup the boundary conditions and rcr options object.

```
Q <- 9.5  # cms
bc_4 <- bc(station=4,reach="Reach1_Name",location="Downstream",bctype="Normal Depth",bcvalue=0.012)
ropt <- rcr_options() # use default rcr_options values
```

Assign the geometries for three cross-sections.

```
xs_4 <- xsection(riverstation="4",station=0,xx=dd_4$xx,zz=dd_4$zz,Manning=dd_4$nn,
                 Manning_LOB=0.05,Manning_Main=0.035,Manning_ROB=0.05,
                 lbs_xx=5.13,rbs_xx=11.12,
                 ds_length_LOB=230,ds_length_Main=230,ds_length_ROB=230,contraction_coeff=0.1,expansion

xs_5 <- xsection(riverstation="5",station=58,xx=dd_5$xx,zz=dd_5$zz,Manning=dd_5$nn,
                 Manning_LOB=0.05,Manning_Main=0.035,Manning_ROB=0.05,
                 lbs_xx=4.52,rbs_xx=13.36,
                 ds_length_LOB=60,ds_length_Main=58,ds_length_ROB=64,contraction_coeff=0.1,expansion_co

xs_6 <- xsection(riverstation="6",station=80,xx=dd_6$xx,zz=dd_6$zz,Manning=dd_6$nn,
                 Manning_LOB=0.045,Manning_Main=0.035,Manning_ROB=0.05,
                 lbs_xx=1.7,rbs_xx=8.93,
                 ds_length_LOB=22,ds_length_Main=22,ds_length_ROB=28,contraction_coeff=0.1,expansion_co
```

Create the geometries from xsection object, and calculate the hydraulic outputs.

```
# create new geometry under variable g02 from two cross-sections
g02 <- geom$new(xsectionList=list(xs_4,xs_5,xs_6),geomname="Existing Condition 20190121")

# check order of g02 items, sort by g02$xsectionList[[1]]$station
g02$xsectionList[[1]]$station
```

```
## [1] 0
```

```
# run hydraulic analysis and check results
hydraulic_output <- rcr::compute_profile(geometry=g02,Q=9.59,boundary_conditions=bc_4,options=ropt)
```

```
## [1] "Beginning backwater calculations."
## [1] "Computing profile for xsection 1"
## [1] "Normal depth estimated successfully."
## [1] "Computing profile for xsection 2"
## [1] "Iterated on WSL within tolerance on iteration 20"
## [1] "Computing profile for xsection 3"
## [1] "Iterated on WSL within tolerance on iteration 9"
## [1] "Successfully completed hydraulic calculations. :-)"
```

```
names(hydraulic_output) # calculated fields
```

```
##  [1] "xsection"          "Flow"              "Flow_LOB"
##  [4] "Flow_Main"         "Flow_ROB"          "Min_Elev"
##  [7] "Depth"             "WSL"               "Velocity"
## [10] "Velocity_LOB"      "Velocity_Main"     "Velocity_ROB"
## [13] "K_Total"           "K_LOB"             "K_Main"
## [16] "K_ROB"             "alpha"             "Area"
## [19] "Area_LOB"          "Area_Main"         "Area_ROB"
## [22] "HRadius"           "HRadius_LOB"       "HRadius_Main"
## [25] "HRadius_ROB"       "WetPerimeter"      "WetPerimeter_LOB"
## [28] "WetPerimeter_Main" "WetPerimeter_ROB"  "Energy_total"
## [31] "Velocity_head"     "Froude"            "Sf"
## [34] "Sf_Avg"            "Length_Effective"  "Head_Loss"
## [37] "Manning_Composite"
```

```
head(hydraulic_output[,1:8]) # truncated output for demo pdf
```

```
##   xsection Flow Flow_LOB Flow_Main Flow_ROB Min_Elev     Depth      WSL
## 1        4 9.59        0      9.59        0   172.94 1.4010184 174.3410
## 2        5 9.59        0      9.59        0   173.95 0.9620051 174.9120
## 3        6 9.59        0      9.59        0   174.44 0.9424935 175.3825
```

Change the parameters in the ropt object, and re-run the calculation.

```
ropt$silent_cp <- TRUE # silence the compute_profile output
ropt$silent_nd <- TRUE # silence the normal_depth output
ropt$dx <- 0.01        # change the interpolated horizontal chainage to 5cm, more coarse resolution

hydraulic_output <- rcr::compute_profile(geometry=g02,Q=9.59,boundary_conditions=bc_4,options=ropt)
```

```
## [1] "Successfully completed hydraulic calculations. :-)"
```

```
head(hydraulic_output[,1:8]) # truncated output for demo pdf
```

```
##   xsection Flow Flow_LOB Flow_Main Flow_ROB Min_Elev     Depth      WSL
## 1        4 9.59        0      9.59        0   172.94 1.4000597 174.3401
## 2        5 9.59        0      9.59        0   173.95 0.9616684 174.9117
## 3        6 9.59        0      9.59        0   174.44 0.9419154 175.3819
```

Use some of the other tools, such as calculating the flow area or the bankfull flow.

```
# estimate bankfull flow for xsection #4; default wsl is lowest defined bank height
bankfull_flow(xs=xs_4,S=0.001,wsl=NA,ropt)
```

```
##       Flow    WSL
## 1 6.426608 175.05
```

```
# or for a presribed water surface level
bankfull_flow(xs=xs_4,wsl=176.0,S=0.001,ropt)
```

```
##       Flow WSL
## 1 13.13986 176
```

```
# calculate flow areas for specific segments
flow_area(xs=xs_4,wsl=176,stns=c(3,5,7,10),ropt)
```

```
##   ID start   end      area
## 1  1     0  3.00 0.3068563
## 2  2     3  5.00 1.1695396
## 3  3     5  7.00 2.8727711
## 4  4     7 10.00 8.3462599
## 5  5    10 14.08 2.2173808
```

```
# calculate normal depth for a given cross-section
normal_depth(xs_4,Q,bc_4$bcvalue, init_WSL=NA, ropt)
```

```
## [1] 174.3327
```

Modify the geometry with a list an additional cross-section.

```
num_xsections <- length(g02$xsectionList)
g02$xsectionList[[(num_xsections+1)]] <- xs_6 # add one item more to list
g02$xsectionList[[4]]$riverstation <- "7"
```

Run multiple flow profiles with new geometry (use wrapper function compute_flow_profiles).

```
hydraulic_outputs <- compute_flow_profiles(geometry=g02,flows=seq(5,20,5),boundary_conditions=bc_4,optic
```

```
## [1] "Successfully completed hydraulic calculations. :-)"
## [1] "Successfully completed hydraulic calculations. :-)"
## [1] "Successfully completed hydraulic calculations. :-)"
## [1] "Successfully completed hydraulic calculations. :-)"
## [1] "Successfully completed hydraulic calculations for 4 flow profiles. :-)"
```

```
head(hydraulic_outputs[,1:8]) # truncated output for demo pdf
```

```
##   xsection Flow     Flow_LOB Flow_Main Flow_ROB Min_Elev     Depth
## 1        4    5 0.0000000000  5.000000        0   172.94 1.0317704
## 2        5    5 0.0003731152  4.999627        0   173.95 1.1159586
## 3        7    5 0.0000000000  5.000000        0   174.44 0.7839987
## 4        7    5 0.0000000000  5.000000        0   174.44 0.8097095
## 5        4   10 0.0000000000 10.000000        0   172.94 1.4276847
## 6        5   10 0.0000000000 10.000000        0   173.95 0.9808035
##        WSL
## 1 173.9718
## 2 174.5757
## 3 175.0349
## 4 175.2497
## 5 174.3677
## 6 174.9308
```