Tutorial 33: Using a Round-Robin realtime multi-tasking system

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Complete List of all Tutorials with Publishable MATLAB Files of this Solid-Geoemtries Toolbox

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Motivation for this tutorial: (Originally SolidGeometry 3.5 required)

Matlab can be converted relatively simply to a realtime-multi-tasking environment according to the round-robin method. The following conditions must apply: A) There is a fixed time base for all tasks B) All tasks are called up one after the other in the fixed time clock

The environment presented in this tutorial has the following properties:

- A) Shell character = While the real-time environment is running, Matlab commands can still be typed as before.
- B) All variables of the real-time environment can be modified directly.

List of supported functions

The input-interpreter routine of the real-time environment has additional commands that superimpose comparable commands on the Matlab command line.

- ***HELP*** - shows a help text
- ***EXIT*** or ***QUIT*** - ends the environment
- ***SHOWLIST*** or ***TASKS*** - shows all tasks
- ***KILLTASKS*** or ***KILLALL*** - removes all tasks
- ***ADD*** - appends a task at the task list
- ***KILLLAST*** - removes the last task
- ***BREAK*** or ***STOP*** - stops the realtime execution
- ***STEP*** - runs the realtime loop only ones
- ***GO*** or ***START*** or ***CONT*** - starts the realtime loop
- ***KILL*** Tasknumber - removes a task with that number
- ***SAVE*** - saves the current task list on disk
- ***LOAD*** - loads the current task list on disk
- ***EXE*** or ***EXECUTE*** filename - executes a command line file
- ***edit*** filename edits a command line file
- ***whos*** shows the variables

Intended use of RRrun or RRshell (both are the same)

- ***RRrun*** - starts the Shell
- ***RRrun*** commandstring (lines are spearated by \r)

1. Starting the shell

The following commands could be typed in absolute in the same way as part of the command string. So please try to type them also manually instead of using them als input parameter of RRrun There is no other chance to create a publishable document as to describe them as input parameter.

```
RRrun 'quit'    % Quit immediately
```

```
RRkeyboardLine =
    'quit'
====LOOP STARTS 03-Oct-2023 08:19:08 for 600 SECONDS with CYCLETIME 0.100 SECONDS===========>> END =======
RRrun>>
TERMINATED by User
================LOOP ENDS 03-Oct-2023 08:19:08 USING 0.11 SECONDS ========================
```

```
RRrun 'RRstop=RRcputime+1;'  % Quit after 1 second
```

```
RRkeyboardLine =
    'RRstop=RRcputime+1;'
====LOOP STARTS 03-Oct-2023 08:19:08 for 600 SECONDS with CYCLETIME 0.100 SECONDS===========>> END =======
RRrun>>
================LOOP ENDS 03-Oct-2023 08:19:10 USING 1.20 SECONDS ========================
```

```
RRrun 'LIST \r QUIT' % show the tasks and quit
```

```
RRkeyboardLine =
    'LIST       QUIT'
====LOOP STARTS 03-Oct-2023 08:19:10 for 600 SECONDS with CYCLETIME 0.100 SECONDS===========>> END =======
RRrun>>RRtasklist =
  struct with fields:

       t0: 0.1000
    twarn: 0.1000
    tstop: 1
      cnt: 0
    tlist: []

TERMINATED by User
================LOOP ENDS 03-Oct-2023 08:19:10 USING 0.20 SECONDS ========================
```

```
RRrun 'whos \r QUIT' % show the variables and quit
```

```
RRkeyboardLine =
    'whos       QUIT'
====LOOP STARTS 03-Oct-2023 08:19:11 for 600 SECONDS with CYCLETIME 0.100 SECONDS===========>> END =======
```

```
RRrun>>  Name               Size            Bytes  Class              Attributes

  RRbreak             1x1                 1  logical
  RRcurs              0x0                 0  double             persistent
  RRdelay             1x1                 8  double             global
  RRkeyboardLine      1x6                12  char               global
  RRlastcommand       1x4                 8  char               global
  RRlastexectime      1x1                 8  double
  RRlasttime          1x1                 8  double             global
  RRmaxtime           1x1                 8  double             global
  RRpause             1x1                 8  double
  RRprompt            1x5                10  char               global
  RRstart             1x1                 8  double             global
  RRstop              1x1                 8  double             global
  RRtasklist          1x1               872  struct             global
  RRwindow            1x1                 8  matlab.ui.Figure   global
  RRwindowNr          1x1                 8  double             global
  cmd                 1x4                 8  char
  remain              0x0                 0  char
  token               1x4                 8  char
  varargin            1x1               128  cell


TERMINATED by User
================LOOP ENDS 03-Oct-2023 08:19:11 USING 0.20 SECONDS ========================
```

```
RRrun ('fprintf(''%.2f\n'',RRcputime) \rQUIT') % show the cputime and quit
```

```
RRkeyboardLine =
    'fprintf('%.2f\n',RRcputime)      QUIT'
====LOOP STARTS 03-Oct-2023 08:19:12 for 600 SECONDS with CYCLETIME 0.100 SECONDS==========>> END =======
RRrun>>4.63


TERMINATED by User
================LOOP ENDS 03-Oct-2023 08:19:12 USING 0.20 SECONDS ========================
```

2. Adding realtime tasks and define the stop time

```
RRrun 'ADD fprintf(''%.2f\n'',RRcputime) \r RRstop=RRcputime+1;' % show the cputime every cycle and quit after 1 second
```

```
RRkeyboardLine =
    'ADD fprintf('%.2f\n',RRcputime)       RRstop=RRcputime+1;'
====LOOP STARTS 03-Oct-2023 08:19:12 for 600 SECONDS with CYCLETIME 0.100 SECONDS==========>> END =======
RRrun>>5.41

5.51
5.61
5.71
5.81
5.91
6.01
6.11
6.21
6.31
6.41
6.51
================LOOP ENDS 03-Oct-2023 08:19:14 USING 1.30 SECONDS ========================
```

3. Adding realtime tasks and change the cycle time

```
RRrun 'ADD fprintf(''%.2f\n'',RRcputime) \r RRtasklist.t0=0.05 \r RRstop=RRcputime+1;'
```

```
RRkeyboardLine =
    'ADD fprintf('%.2f\n',RRcputime)       RRtasklist.t0=0.05       RRstop=RRcputime+1;'
====LOOP STARTS 03-Oct-2023 08:19:14 for 600 SECONDS with CYCLETIME 0.100 SECONDS==========>> END =======
RRrun>>7.22
RRtasklist =
  struct with fields:

       t0: 0.0500
    twarn: 0.1000
    tstop: 1
      cnt: 2
    tlist: {' fprintf('%.2f\n',RRcputime)'  [Inf]  [1]}

7.27

7.32
7.37
7.42
```

```
7.47
7.52
7.57
7.62
7.67
7.72
7.77
7.82
7.87
7.92
7.97
8.02
8.07
8.12
8.17
8.22
8.27
8.32
================LOOP ENDS 03-Oct-2023 08:19:15 USING 1.30 SECONDS ========================
```

4. Adding realtime tasks and change the cycle time and kill the task

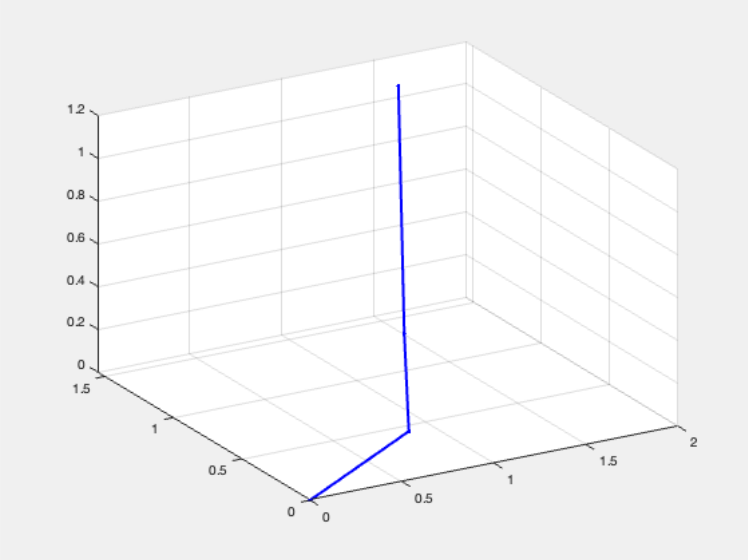
```
RRrun 'ADD fprintf(''%.2f\n'',RRcputime) \r RRtasklist.t0=0.05 \r KILLLAST \r RRstop=RRcputime+1;'
```

```
RRkeyboardLine =
    'ADD fprintf('%.2f\n',RRcputime)       RRtasklist.t0=0.05       KILLLAST       RRstop=RRcputime+1;'
====LOOP STARTS 03-Oct-2023 08:19:16 for 600 SECONDS with CYCLETIME 0.100 SECONDS===========>> END =======
RRrun>>9.01
RRtasklist =
  struct with fields:

       t0: 0.0500
    twarn: 0.1000
    tstop: 1
      cnt: 2
    tlist: {' fprintf('%.2f\n',RRcputime)'  [Inf]  [1]}

9.06
RRtasklist =
  struct with fields:

       t0: 0.0500
    twarn: 0.1000
    tstop: 1
      cnt: 2
    tlist: {0×3 cell}

================LOOP ENDS 03-Oct-2023 08:19:17 USING 1.35 SECONDS ========================
```

5. Run a plotting task and save the task list by using "save"

```
RRrun 'KILLALL \r global PL; PL=[0 0 0]; \r  ADD global PL; PL=[PL; PL(end,:)+rand(1,3)]; \r ADD global PL; delete(gca); VLplot(PL,''b.-'',2); view(-30
```

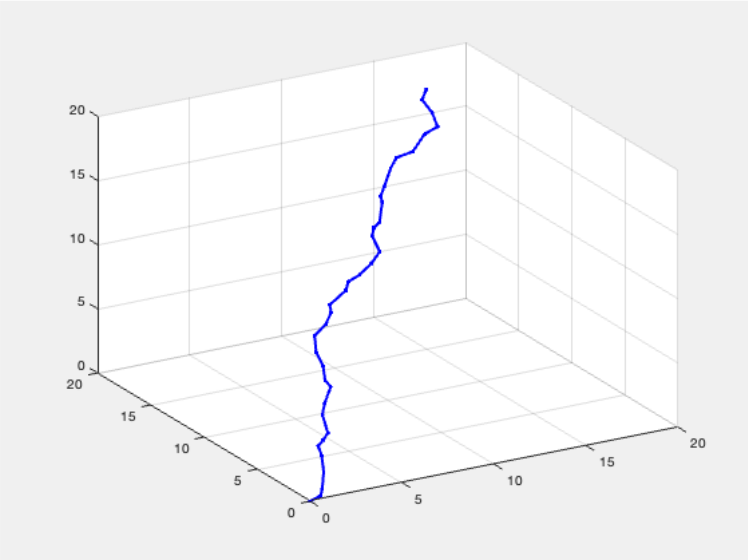
```
RRkeyboardLine =
    'KILLALL       global PL; PL=[0 0 0];        ADD global PL; PL=[PL; PL(end,:)+rand(1,3)];       ADD global PL; delete(gca); VLplot(PL,'b.-',2); vie
====LOOP STARTS 03-Oct-2023 08:19:18 for 600 SECONDS with CYCLETIME 0.100 SECONDS===========>> END =======
RRrun>>RRtasklist =
  struct with fields:

       t0: 0.1000
    twarn: 0.1000
    tstop: 1
      cnt: 0
    tlist: []


RRtasklist saved in RRtasklist.mat
  Name            Size            Bytes  Class     Attributes

  RRtasklist      1x1              1744  struct    global


RRrun: realtime condition broken by 110 milliseconds


RRrun: realtime condition broken by 594 milliseconds

================LOOP ENDS 03-Oct-2023 08:19:22 USING 4.63 SECONDS ========================
```



6. Run the saved task a second time by using "load"

```
RRrun 'load \r start \r copyplot \r RRstop=RRcputime+3;'
```

```
RRkeyboardLine =
    'load       start       copyplot       RRstop=RRcputime+3;'
====LOOP STARTS 03-Oct-2023 08:19:24 for 600 SECONDS with CYCLETIME 0.100 SECONDS==========>> END =======
RRrun>>
New RRtasklist loaded from RRtasklist.mat


RRrun: realtime condition broken by 499 milliseconds

================LOOP ENDS 03-Oct-2023 08:19:28 USING 4.03 SECONDS ========================
```

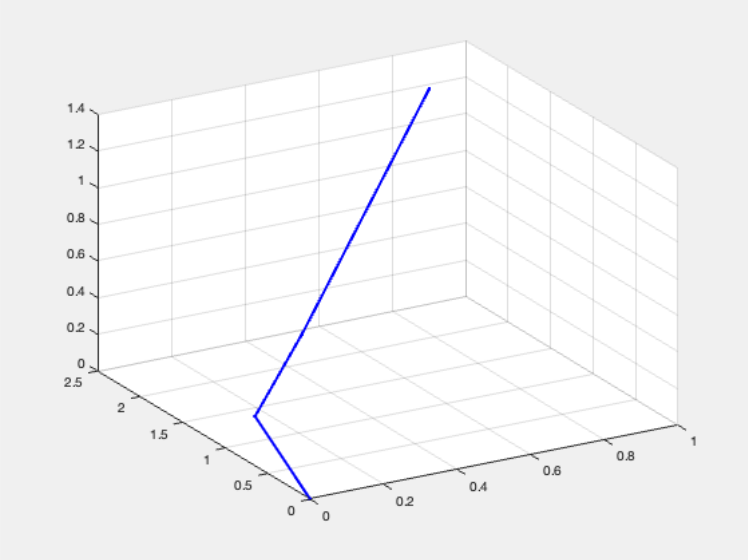


7. Execute a command file

```
RRrun 'execute RRrun_testcommands.txt'
```

```
RRkeyboardLine =
    'execute RRrun_testcommands.txt'
====LOOP STARTS 03-Oct-2023 08:19:28 for 600 SECONDS with CYCLETIME 0.100 SECONDS==========>> END =======
```

```
RRrun>>fname =
    'RRrun_testcommands.txt'
Warning: Inputs must be character vectors, cell arrays of character vectors, or
string arrays.

Error using eval
Unrecognized function or variable 'zuschaurKILLALL'.

RRtasklist =
  struct with fields:

       t0: 0.1000
    twarn: 0.1000
    tstop: 1
      cnt: 4
    tlist: {2×3 cell}
ans =
  2×3 cell array
    {' global PL; PL=[P…'}    {[Inf]}    {[1]}
    {' global PL; delet…'}    {[Inf]}    {[3]}
RRtasklist currently stopped. Use "START" or "STEP" to start task execution.

Elapsed time is 0.017155 seconds.



RRrun: realtime condition broken by 472 milliseconds

RRrun>>================LOOP ENDS 03-Oct-2023 08:19:32 USING 4.01 SECONDS ========================
```



8. Edit a command file

```
edit 'RRrun_testcommands.txt'
```

Final Remarks

```
close all
VLFLlicense
```

```
This VLFL-Lib, Rel.  (2023-Oct-03), is for limited non commercial educational use only!
Licensee: Tim Lueth (Development Version)!
Please contact Tim Lueth, Professor at TU Munich, Germany!
WARNING: This VLFL-Lib (Rel. ) license will exceed at 06-Jul-2078 08:19:33!
Executed 03-Oct-2023 08:19:35 by 'timlueth' on a MACI64 using Mac OSX 13.6 | R2023a Update 5 | SG-Lib 5.4
======================================== Used Matlab products: ========================================
database_toolbox
distrib_computing_toolbox
fixed_point_toolbox
image_toolbox
map_toolbox
matlab
simmechanics
simscape
simulink
=======================================================================================================
```

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