1. Release Information

**Version: 0.1.0 Beta**

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**Contact: Yavor.panev@arup.com**

1. Requirements

The run the module your system must have appropriate installation of:

* Conda 4.9 or higher (this should be the default Arup Shop Anaconda/Miniconda installation)

To check the version of conda type in the terminal: conda –version

This tool is currently tested and developed for:

* FDS 6.1.2
* FDS 6.7.3

1. Installation
2. Open console window in the downloaded repository folder.
3. Type cd src.
4. Type conda env create -f requirements.yml.
5. Running
   1. Single run
6. 1. Open src\config.json file.
7. Update *output\_loc* field with pathway to a common folder where diagnostic result will be output (e.g "C:\\local\_work\\digital\_projects\\fds\_diagnostics"). This can be also a shared One-Drive folder if the windows explorer mapping is used.

**Note: Do not forget enclosing "" and use \\ instead of \.**

1. Update other config options - see Section 3 for more information.
2. Save src\config.json.
3. Open src\submit\_sim.txt and paste the file path to each simulation root folder

Example:

[*\\fircls01\data\fds\project\_1\sim\_1*](file:///\\fircls01\data\fds\project_1\sim_1)

*\\fircls01\data\fds\project\_1\sim\_2*

*\\fircls01\data\fds\project\_2\sim\_1*

**Note: Paste the path as copied from Windows explorer. No need for enclosing "" and for \\.**

1. Save src\submit\_sim.txt
2. Double click on start.bat to start the parsing tool. The tool will parse all simulations pasted in the submit\_sim.txt file in accordance with the configurations specified in the config.json file. Outputs will be saved in the specified output location. Update the config file only when you desire changes in the outputs. Any time the tool is started all the latest modification of the simulation files are parsed and all results are automatically updated.
   1. Scheduled run

For continuous tracking is useful to schedule the tool to run automatically at a set interval. To do so:

1. Follow steps 1 to 6 as per 3.1 above
2. Start *Task Scheduler*
3. Click *Create Task* and setup appropriate time intervals.

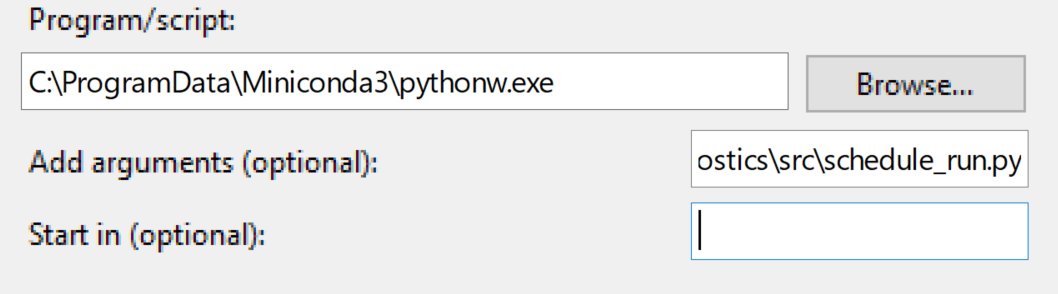
Tip: Scheduling a task every 1 h should be more than enough considering typical progression speeds of FDS simulations

1. At Actions tab set ‘start a program’. Update the option fields:

Program/script: full path to **pythonw.exe.** To find the path for your system open start menu > start typing python > right-click the application > click ‘open file location’ > copy the full file path from the explorer

Add arguments: Full path to src/schedule\_run.py

Example setup:



1. Verify the conditions tab whether default conditions do not interfere with the task setup
2. Click ok to close the task setup window and create the task
3. To immediately test the created scheduled task click on ‘Task Scheduler Library’ > Locate the created task > Right-click and select run. If setup correctly the script should silently activate and parse the relevant data with updated time stamps. Appropriate logs should also be created
4. Application structure (to be revised)

The application is composed of the following components:

* Simulation data parser – parses all relevant runtime data and simulation information data from \*.out file as per the specified configuration.
* Mesh data parser – parses relevant mesh definition data from the \*.fds file.
* HRR data parser – parses fire definition relevant data from the \*.fds file.
* Obstruction parser – parses obstructions relevant data from the \*.fds file. Processes geometry images in xy, yz, and xz projections which are later used in location plots
* Analytics module – performs various diagnostic analytics on parsed data.
* Plotting components – plots parsed data in curated graphs.

1. Configuration file contents

|  |  |  |
| --- | --- | --- |
| Field | Data type | Explanation |
| **Settings** | | |
| output\_loc | string | Filepath to folder location where diagnostic output will be stored |
| **Log\_data** | | |
| ts | bool | Time step data |
| press\_itr | bool | Pressure iterations data |
| vel\_err | bool | Velocity error data |
| press\_err | bool | Pressure error data (only for v 6.7.3) |
| cycles | bool | Cycles (time-step number) data |
| max\_div | bool | Max divergence data per each mesh |
| min\_div | bool | Min divergence data per each mesh |
| vn | bool | VN number data per each mesh |
| cfl | bool | CFL number data per each mesh |
| hrr | bool | Heat release rate data per each mesh |
| nrg\_loss | bool | Radiation loss data per each mesh |
| cpu\_step | bool | Time per time state data (only for v 6.1.2) |
| **Plots** | | |
| time\_progress | bool | Simulation progression plot featuring current simulation progression speed and predicted runtimes to reaching various time horizons |
| ts | bool | Time step – simulation time plot |
| cfl | bool | CFL number – simulation time plot |
| ts\_time | bool | Time per time step – simulation time plot |
| min\_div | bool | Min divergence – simulation time plot |
| max\_div | bool | Max divergence – simulation time plot |
| vn | bool | VN number – simulation time plot |
| hrr | bool | HRR – simulation time plot |
| vel\_err | bool | Velocity error – simulation time plot |
| press\_err | bool | Pressure error – simulation time plot |
| press\_itr | bool | Pressure iterations – simulation time plot |
| vn\_loc | bool | Max VN number location plot |
| max\_div\_loc | bool | Max divergence location plot |
| min\_div\_loc | bool | Min divergence location plot |
| cfl\_loc | bool | Max CFL number location plot |
| vel\_err\_loc | bool | Max velocity error location plot |
| Press\_err\_loc | bool | Max pressure error location plot (available only for v6.7.3) |
| last\_loc\_pts | integer | Number of last log points to be highlighted on any of the location plots |
| **Utils** | | |
| hrr\_als | bool | Parses fire definition information |
| Obstruction\_als | bool | Parses obstruction information |

*Note: The first time the tool is run on a simulation the master config file from the application src folder will be copied to the respective simulation data output folder. In subsequent runs the user may edit the copied config file to achieve specified output for each analysed simulation.*

1. Output data
   1. Graphical data

Please view the powerpoint graphics.docx for explanation of the graphical output. Data for the graphical output is parsed as human readable csv and json files in the /data folder.

* 1. Tabular and relational data

All relevant parsed data is output in human readable csv files and jsons in the /data folder for each simulation output. Contents of each file is explained below:

**File sim\_info.json**

|  |  |  |
| --- | --- | --- |
| Field | Unit | Explanation |
| ver | - | Full FDS version used for the simulation |
| chid | - | Simulation ID |
| date\_start | - | Start time and date of the simulation |
| cores\_n |  | Number of cores |
| sim\_end | s | Simulation time duration |
| tot\_elp\_time | s | Total clock time needed for the simulation to complete |
| stop\_cond | - | Stop condition (if present) |

**File mesh\_data.json**

|  |  |  |
| --- | --- | --- |
| Field | Unit | Explanation |
| mesh\_info | - | Dictionary of meshes each containing mesh definition data in a list of numbers following standard FDS definition of mesh: [xn, yn, zn, xmin, xmax, ymin,ymax,zmin,zmax, total number of elements in a mesh] |
| tot\_el | - | Total number of elements in the simulation |
| grid\_size | - | Dictionary of meshes containing the grid size for each mesh |
| total\_vol | m3 | Total volume of the model (including obstructions) |
| range | - | Dictionary containing the model span in x, y, and z direction as well as xmax, xmin,ymax,ymin,zmax,zmin ranges |
| obst\_vol | m3 | Total volume of obstructions defined in the model discretised to the obst\_discr parameter |
| air\_vol | m3 | Total air volume (total volume – obstructions volume) |
| obst\_discr | - | Discretisation parameter adopted by the obstruction parser |

**File hrr\_data.json**

|  |  |  |
| --- | --- | --- |
| Field | Unit | Explanation |
| area | m2 | Total area of all burners in the model |
| react | - | Reaction information including reaction ID, FYI, reaction products stoichiometry, soot yield, coo yield |
| Max\_HRR | KW | Maximum HRR |
| time\_max\_HRR | s | Time to maximum HRR |
| loc | m | fire location [x, y] |
| hrrpua | KW/m2 | Heat release rate per unit area |
| surf |  | Specific information for each fire surface – obstruction area, associated curve, associated HRRPUA |
| gr\_rate | - | Predicted standard growth rate: slow, medium, fast, ultrafast or undef |
| gr\_rate\_err | KW | Difference between specified time to max HRR and theoretical as per categorized fire growth rate. If difference is more than 10% then undef. is given |

**File cfl.csv**

Contains CFL number numerical data and absolute model location of each data point for each mesh.

**File vn.csv**

Contains VN number numerical data and absolute model location of each data point for each mesh.

**File max\_div.csv**

Contains max divergence numerical data and absolute model location of each data point for each mesh.

**File min\_div.csv**

Contains min divergence numerical data and absolute model location of each data point for each mesh.

**File cycle\_info.csv**

Contains relevant data for each cycle:

* Pressure iterations
* Time step size
* Maximum velocity error and model location
* Maximum pressure error and model location (available only for v6.7.3)
* Number of cycles

**File nrg\_loss.csv**

Contains radiation energy loss to boundaries numerical data for each mesh where available.

**File hrr.csv**

Contains heat release rate numerical data for each mesh where available.

**File lagr.csv**

Contains langrange points numerical data for each mesh where available.

**File hrr\_curve.csv**

Contains parsed hrr curve as defined in the .fds file.

* 1. Images

Projection images from the CFD model are saved in the /img folder. These are currently used for visualisation of the location plots

1. Analytical models (to be updated)

This section summarises currently deployed analytical models

* 1. Simulation status identification

Identifies the current status of the simulation according to the following rules

|  |  |
| --- | --- |
| Status | Rule |
| **Simulation Interrupted** | Simulation has not progressed in the last 24h and no stop condition is declared |
| **Simulation Delayed** | Simulation has not progressed over a time larger than 95% of the moving standard deviation of log intervals for the last 30 logs. |
| **Simulation Completed** | Simulation has finished correctly. |
| **Simulation Terminated by User** | Simulation has been terminated by the user using .stop |
| **Numerical Instability** | Simulation terminated due to numerical instability |
| **Simulation Running** | No stop condition present and simulation progression is in the 95% interval of the last 30 entries |

* 1. Runtime prediction model

Identifies the time the simulation to reach specified time horizon

Currently deployed model is mAvg-30-v0.1.0

Concise description:

* Time to reach specific simulation time horizon is predicted based on the simulation speed moving average for the last 30 entries
* Uncertainty in predictions is based on the moving standard deviation for the last 30 entries

*Note: This model is only appropriate once the simulation has settled to a relatively stationary progression speed which usually occurs after the first 200 s for a t2 fire. Predictions before that will be very inaccurate due to the high variance and will be communicated by the very high uncertainties.*

1. Logging

The tool utilises two streams of logs

Master log

* Located in src/logs/main\_log.log
* Logs each time the application is started
* Counts number of warnings, errors and critical errors that occur for each simulation
* Logs complete traceback of critical exceptions handled by the main control loop of the tool

Simulation log

* Located in simulation\_output\_folder/logs/sim\_log.log
* Logs start and finish of each component
* Logs sizes of parsed data
* Logs complete traceback any time a component fails

1. Release known issues

* Connection problems to the cluster may result in the following exception: *Exception: Multiple or no \*.fds files*
* Design fire information parser works only for fires defined via surfaces and ramp curves