

Condensation Readme

Description:

This dataset contains acoustic and corresponding thermofluidic measurements from flow condensation tests conducted using NASA's Condensation Module for Heat Transfer (CM-HT) module of the Flow Boiling and Condensation Experiment (FBCE). The test section is a tube-in-tube condenser, where the working fluid n-Perfluorohexane (nPFH) flows through an inner tube with a diameter of 7.12 mm and a length of 574.6 mm. Cooling water circulates in counterflow over the inner tube.

Flow condensation is monitored using an acoustic emission sensing technique. The dataset includes measurements under varying conditions of nPFH flow rate (Gnpfh), cooling water flow rate (Gw), inlet nPFH vapor quality (x), and horizontal and vertical orientations.

Data structure:

The dataset files can be read as follows:

/dataset

```
|—— Gnpfh<A>Gw<B>x<C>dir<D>p<E>/ # Individual test folders (one per test)
| |—— AE/ # Contains all AE data from the test
| | |—— inlet/ # Time-series collected from the inlet AE sensor
| | | |—— inlet_*.csv # CSV files containing inlet sensor waveforms
| | |—— outlet/ # Time-series collected from the outlet AE sensor
| | | |—— outlet_*.csv # CSV files containing outlet sensor waveforms
| | |—— inlet_primary.txt # Statistical features calculated from each inlet waveform
| | |—— outlet_primary.txt # Statistical features calculated from each outlet waveform
| |—— Acce.txt # Accelerometer time-series data
| |—— Thermal Data.xlsx # Thermofluidic data
|—— README.txt # This file
|—— sensor_locations.xlsx # Mapping of sensors and their positions in the setup
```

Test Folder Naming:

ex) Gnpfh4_6_Gw25_x1_15_dirVD_p18_9

Gnpfh - nPFH (condensing vapor) mass flowrate in grams/second (e.g. 4.6g/s)

Gw - cooling water mass flowrate in grams/second (e.g. 25g/s)

x - target inlet vapor quality, unitless (e.g. 1.15)

dir - condenser orientation, VD: vertical downflow, VU: vertical upflow, H: horizontal

p - target inlet pressure in pounds per square inch absolute (e.g. 18.9psia)

AE Waveform Naming:

<sensor>_<test number>_<AE channel>_<hit number>_<elapsed time>

sensor - AE sensor that recorded the waveform, inlet or outlet

test number - test number associated with the waveform

AE channel - channel of the AE DAQ that the sensor was attached to

hit number - number of the hit associated with the AE waveform

elapsed time - elapsed time since the start of the recording, in microseconds

There is a Python notebook, *Condensation.ipynb*, used to visualize the data and apply unsupervised machine learning for clustering selected datasets.

References:

Wallen, D., Yan, L., Dunlap, C., Li, C., Hu, H. and Sun, Y., 2025. Unsupervised machine learning framework for non-destructive acoustic emission sensing of flow condensation. *AI Thermal Fluids*, p.100010.