SAND2016-7676PE

Summer 2016 HyRAM Improvements

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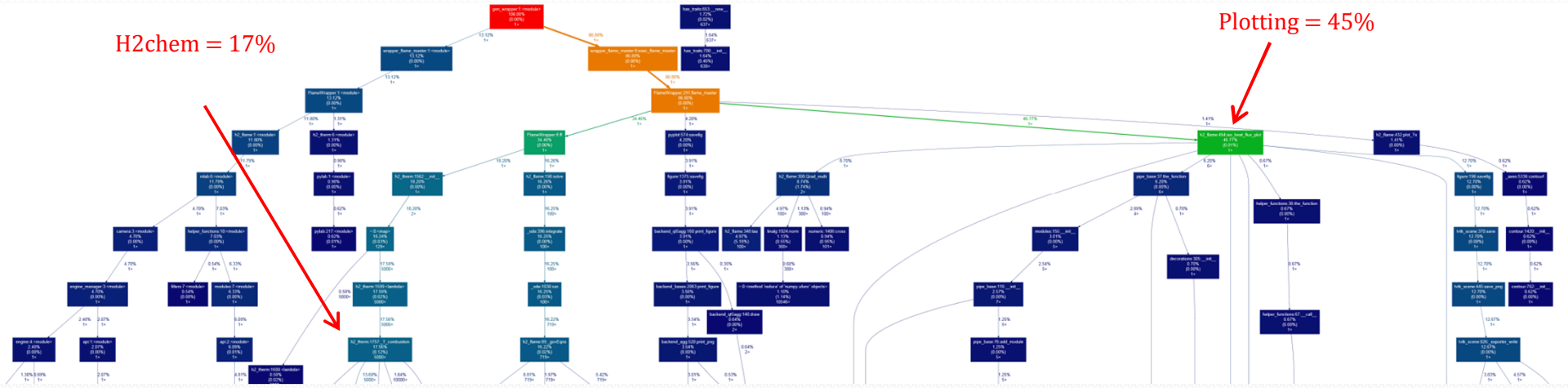
Problem

- Original problems to address:
  - QRA mode runs slowly
  - Legacy duplicated functionality: some physics for QRA mode calling C# version, some calling Python version
- Other problems that arose:
  - Code verification (Python and C#) needed
  - Lack of documentation of numerical methods

Approach

- Runtime Improvement
  - Profiled code to identify most time consuming portions
    - Identified unnecessary generation of plots for QRA mode
    - Time-consuming generation of object for H_2 combustion calculations – recomputed for each leak size in QRA mode



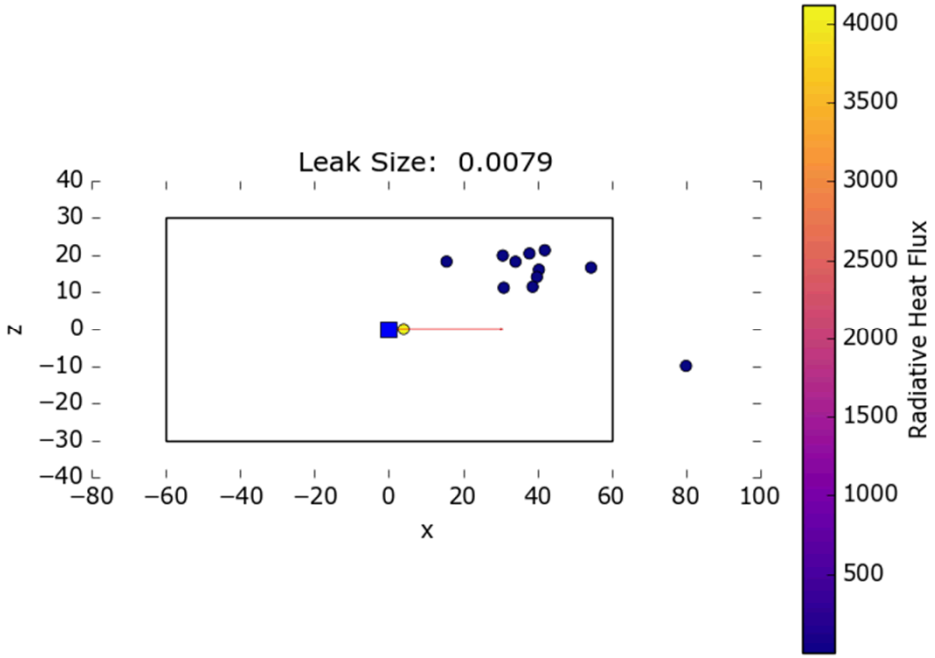
Approach (cont.)

- Code Verification:
  - Line-by-line walkthrough of code comparing against technical reference manual
  - Checked to ensure frontend (C#) and backend (Python) were joined correctly

- Line-by-line walkthrough also allowed:
  - Noted any numerical methods
  - Identified legacy physics in C# code

Accomplishments

- Code Verification
  - Identified and fixed some bugs:
    - Orifice diameters computed with a few different formulas
      - Fix: Identified the correct formula, ensured computed correctly
    - C# generated positions not correctly tied in to Python physics
      - Fix: Overhauled position generator
      - Added position plots
    - Small errors in technical reference manual noted and corrected



Accomplishments (cont.)

- Runtime Improvement:
  - Decreased runtime from 7.75 mins to 2.5 mins for QRA mode (approximate)
  - Also investigated parallelism for different leak sizes
    - Spawn one process for each leak size
    - Current tests show no significant improvement
- Code Clean-up:
  - Removed C# straight flame
  - Connected other notional nozzle models and radiative source models to QRA mode
  - Other minor code improvements
- In-Progress Work:
  - Working with John to tie in new position generator to frontend
  - Adding documentation of numerical methods to technical reference manual

About Me

- Computer Science PhD student at UIUC (University of Illinois Urbana-Champaign)
- Research Group: Scientific Computing
- Thesis Research:
  - New numerical method for solving linear systems