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Ablation Workshop Test Case

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A simple one-dimensional test case is defined for the purpose of inter-code comparison. This year the focus is set on in-depth physics and chemistry. Material properties, boundary conditions, and output format are provided.

I. Test case objectives

Three types of material-response codes have been identified in the community:

- Type 1: CMA type codes (heat transfer, pyrolysis decomposition, simplified transport of the pyrolysis gases)
- Type 2: CMA + Averaged momentum equation for the transport of the pyrolysis gases
- Type 3: Higher fidelity codes (possibly including treatment of the finite-rate chemistry, multi-component diffusion, radiative heating, etc).

There are two objectives to this test:

1. inter-calibration of codes of the same type (focus: numerics and interpretation of the data);
2. comparison of codes of different types (focus: modeling approach).

II. Test case

For this first inter-comparison exercise, we decided to use a simple test case. The idea for this year is to compare the in-depth physics and chemistry implemented in the codes.

Summary of the one-dimensional test for 2011: sample of TACOT of 5 cm, heated on one side at 1664K for 1 minute at atmospheric pressure, adiabatic boundary condition on the other side.

Initial conditions: p= 1atm (101325 Pa), T= 298K, sample length: 0.05 m. The initial gas composition in the material is left open.

Boundary conditions:

- Temperature: Top: t=0 s, T=298 K; t=0.1 s, T=1644 K; t=60 s, T=1644K / Bottom: adiabatic
- Pressure: Top: p = 1 atm / Bottom: impermeable.

More elaborated test cases will be defined for next year (surface recession, multi-dimensional).

III. Material data

The material properties are furnished in the attached spreadsheet (TACOT_1.5.xls). Equations referencing to the way the material properties are used in CMA/FIAT are provided in the spreadsheet. For more information on the CMA model, please consult the CMA manual (provided in the 'reference' directory).

IV. Code output

The type of output desired is provided in the directory 'output'. A suggested plot format for visual comparison is proposed in figure 1.

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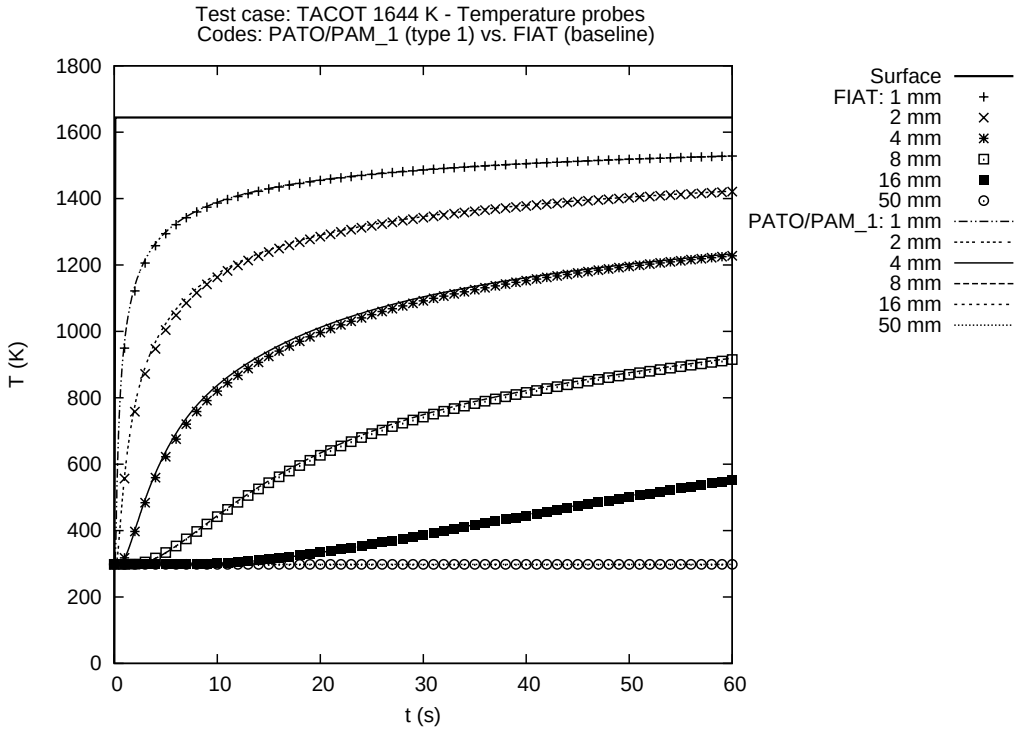


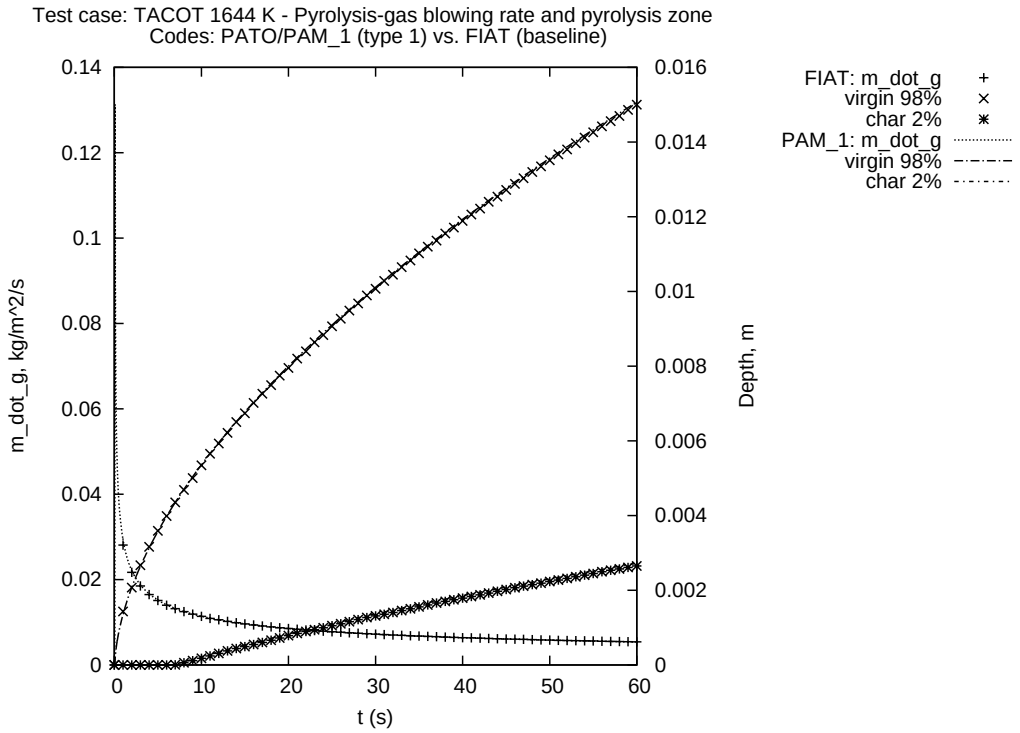
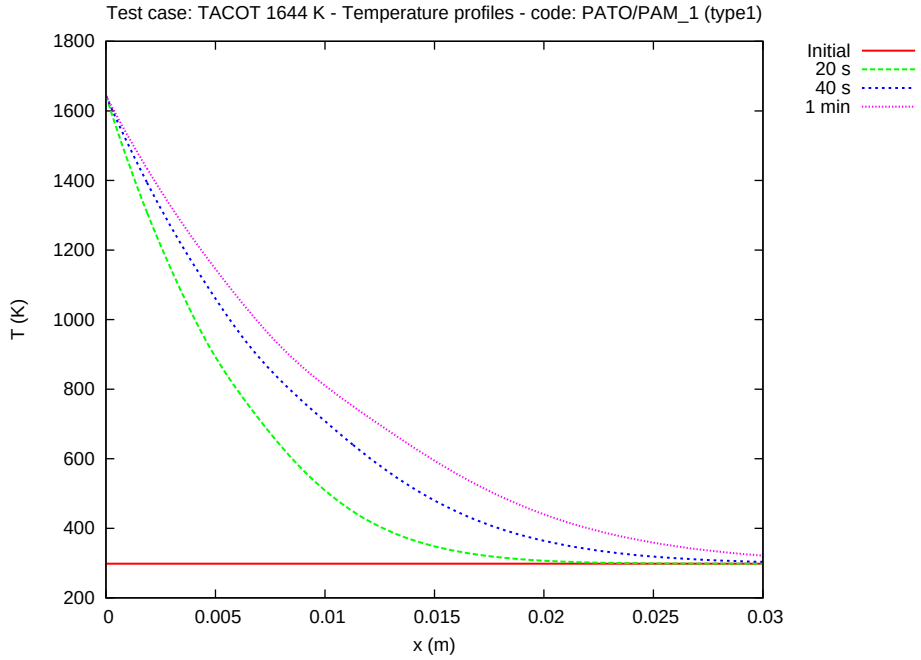
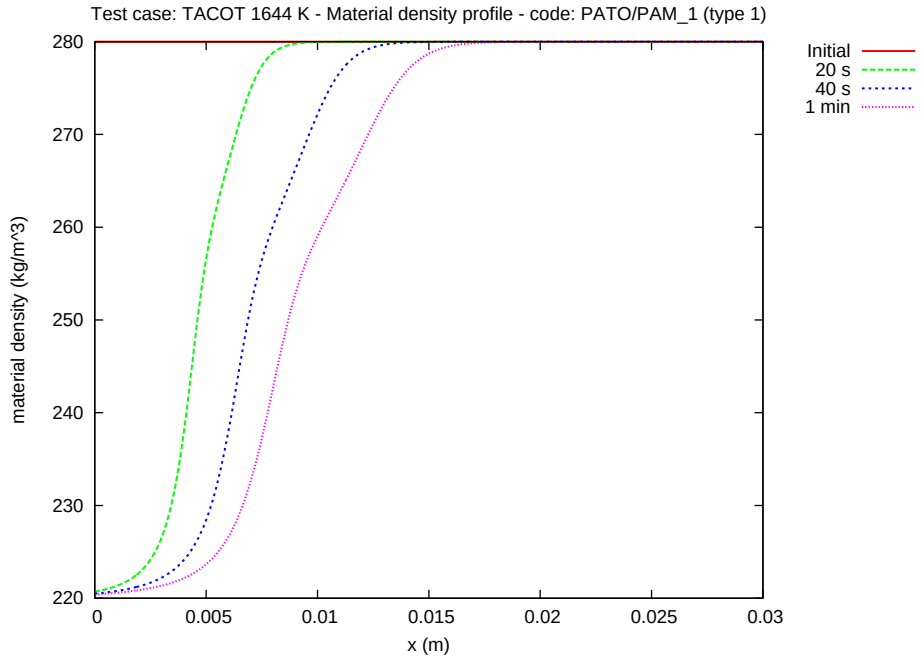


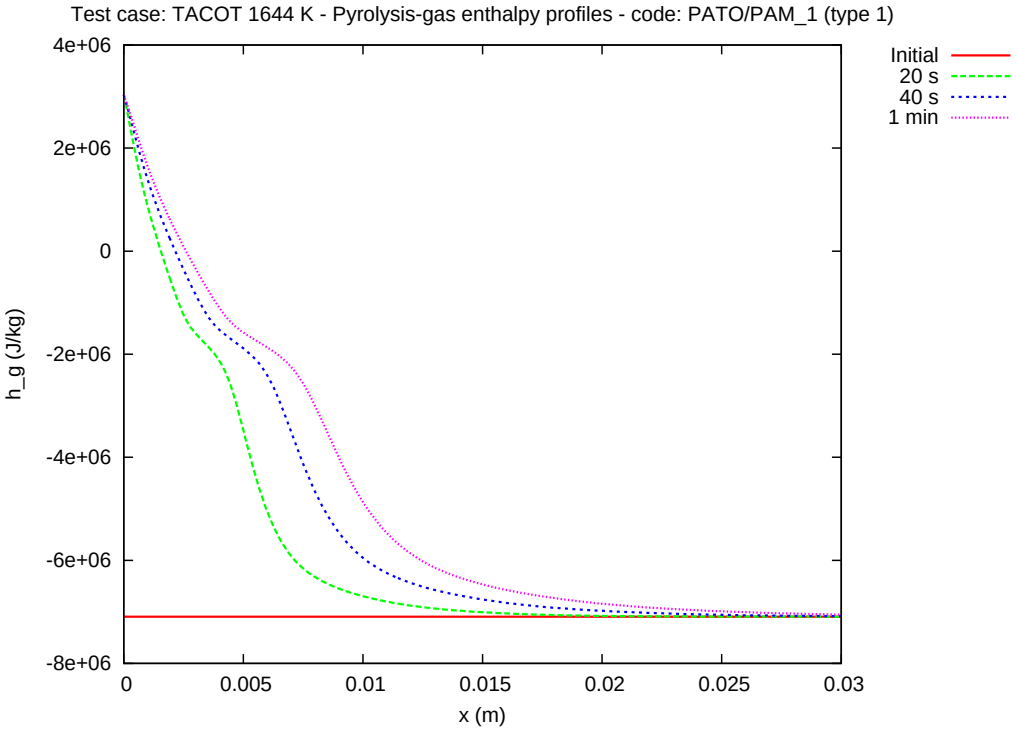
Figure 1. Suggested format for visual comparison of the results. We suggest to use FIAT results (provided in the Thermal Performance Data Base - TPDB) as the baseline for visual comparison. [$\rho_v(98\%) = \rho_c + 0.98(\rho_v - \rho_c)$; $\rho_c(2\%) = \rho_c + 0.02(\rho_v - \rho_c)$]

V. Appendix: Temperature, Density, and gas-enthalpy profiles

The following plots were asked by some code developers. PATO plots are tentatively provided. Corresponding FIAT outputs will be generated soon and placed in the Thermal Performance Data Base (TPDB).






Test case: TACOT 1644 K - Pyrolysis-gas enthalpy profiles - code: PATO/PAM_1 (type 1)
h_g (J/kg)
x (m)
4e+06
2e+06
0
-2e+06
-4e+06
-6e+06
-8e+06
0
0.005
0.01
0.015
0.02
0.025
0.03
Initial
20 s
40 s
1 min