# Gas Turbine Blow-off Research Report

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*Made with support of MATLAB and LaTeX.

# 1 Introduction

Gas turbines have a problem of blow-off. Basically, due to . To investigate this problem, following sub-steps were introduced:
1. Simulation of a single fuel droplet in a gas turbine
2. Determination of the most efficient operating interface conditions
3. Full 3D simulation in OpenFoam which includes numerical and visual study (latter is purely out of curiosity)

```
*********************************************************************
*                                                                   *
*                                                                   *
*   Conditions for a one-dimensional flame                          *
*                                                                   *
*                                                                   *
*********************************************************************
Left boundary
CH3OH   :  5.00    -
N2      : 79.00    -
O2      : 21.00    -
P       :  1.00     BAR
T       : 320.0E+00 K
****v       : 0.000E-02
END
Right boundary
N2      : 0.79     -
H2O     : 21.0     -
O2      : 0.21     -
P       : 1.00     BAR
T       : 1280.    K
END
Conditions................(FORMAT A4,1X,E10, END WITH -END -)
```

Figure 1: Conditions Example

Left boundary is the initial conditions for the droplet of some mixture (methanol + air[?]), while right boundary is the environment. This is literally the situation that happens in a gas turbine (little fuel particles in high temperature air).

After solving the above configuration (but with 50 CH3OH, which does not directly mean 50 percent methanol overall, normalization has to be considered), the following graph is obtained. With red being the first and blue being the last steady(stable) solutions, we see that at the beginning the temperature in the core of the droplet was, as we set, 300K and with increasing radius there is sharp increase, which is expected. The blue solution - though obviously - suggests that in the end of the evaporation reaction, the ultra-tiny methanol particles are now uniformly at ambient temperature .

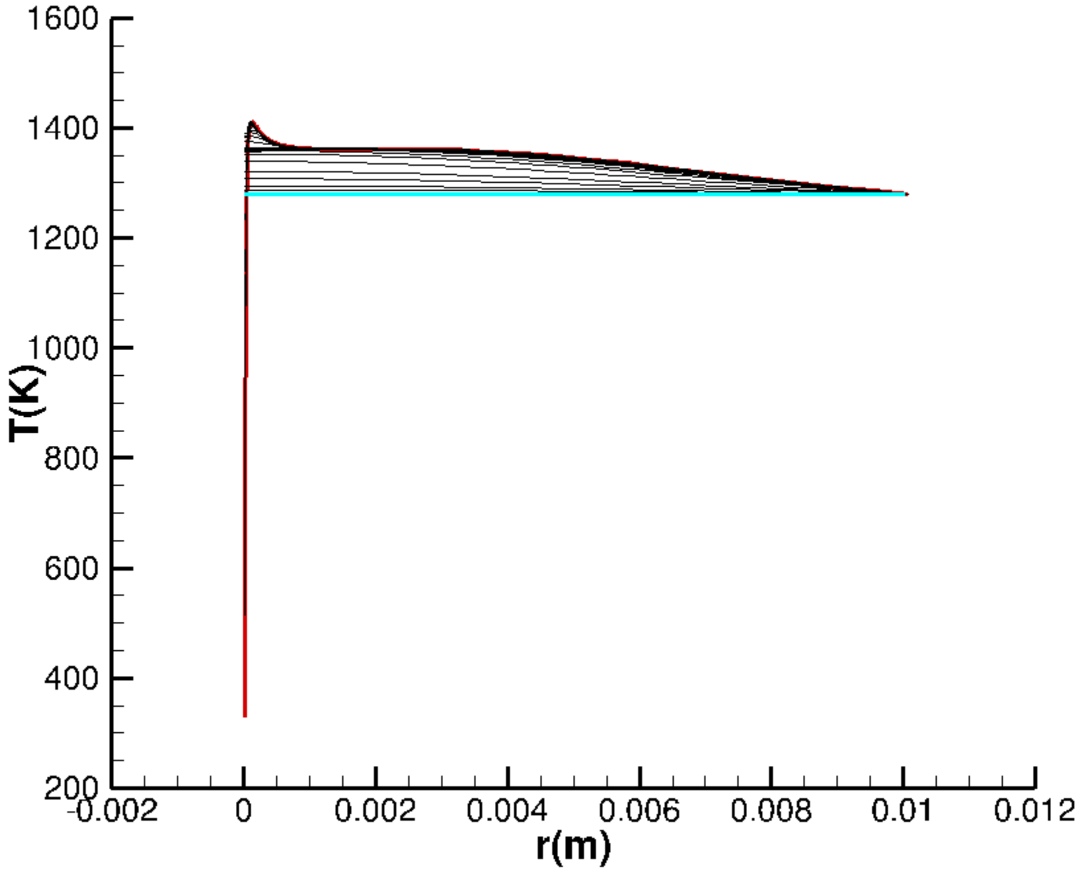


Figure 2: Hehe turbine go brrr

```
***********************************************************************
*                                                                     *
*                                                                     *
*   Conditions for a one-dimensional flame                            *
*                                                                     *
*                                                                     *
***********************************************************************
Left boundary
CH3OH   : 50.00    -
N2      : 79.00    -
O2      : 21.00    -
P       :  1.00     BAR
T       : 300.0E+00 K
****v       : 0.000E-02
END
Right boundary
N2      : 0.79     -
H2O     : 21.0     -
O2      : 0.21     -
P       : 1.00     BAR
T       : 1700.    K
END
Conditions...............(FORMAT A4,1X,E10, END WITH -END -)
```

Figure 3: Hehe I love bauyrsaqs

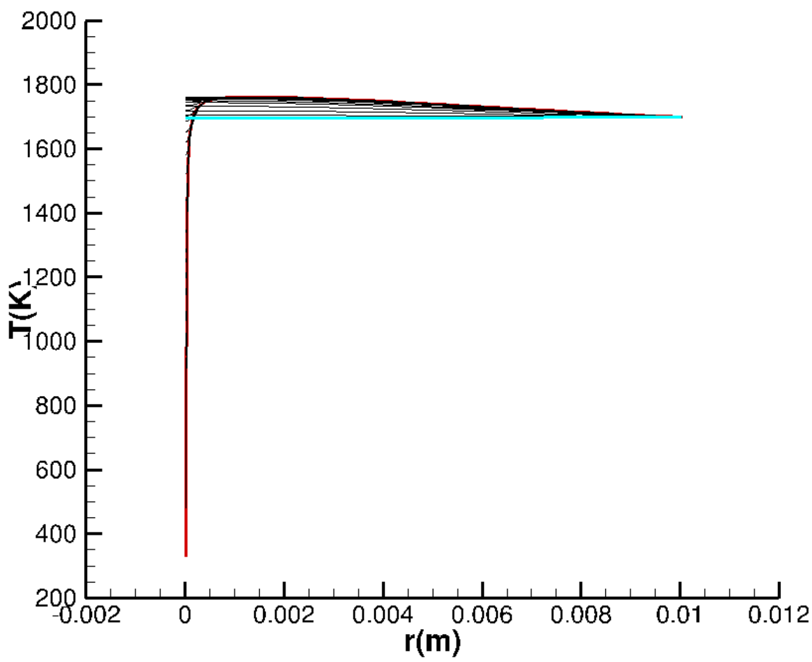


Figure 4: Hehe another solution but with different conditions

Now the question. Why does the droplet have higher than ambient temperature? Is it due to ignition? If so, do we consider evaporation as ignition byproduct?