DEMAGAGGER, a tool for optimizing the coolant flow distribution in core configurations based on closed assemblies

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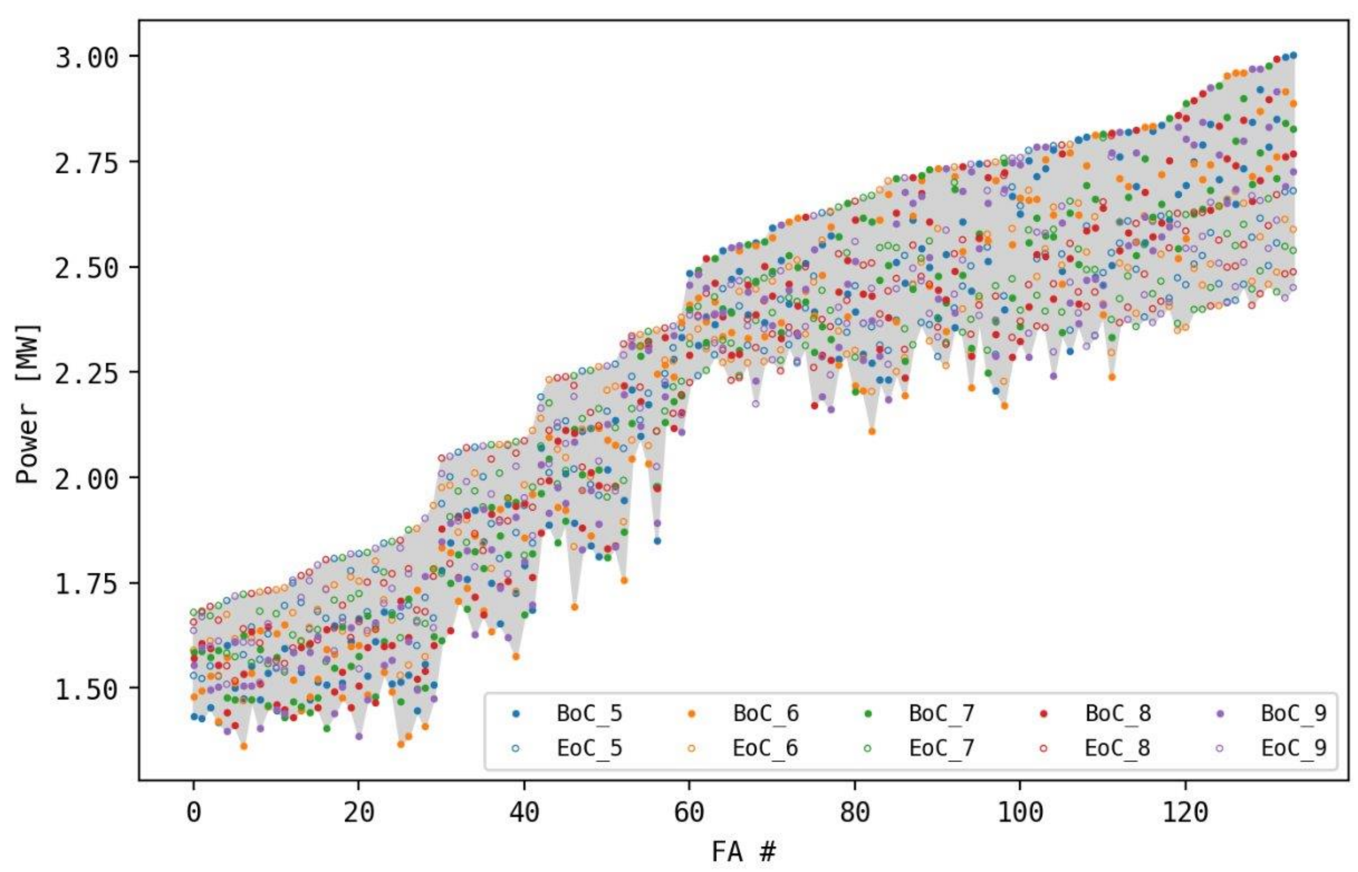


Distribution of fuel assembly integral power values over Begin of Cycle and End of Cycle instants of a 5-batch scheme for the ALFRED reactor

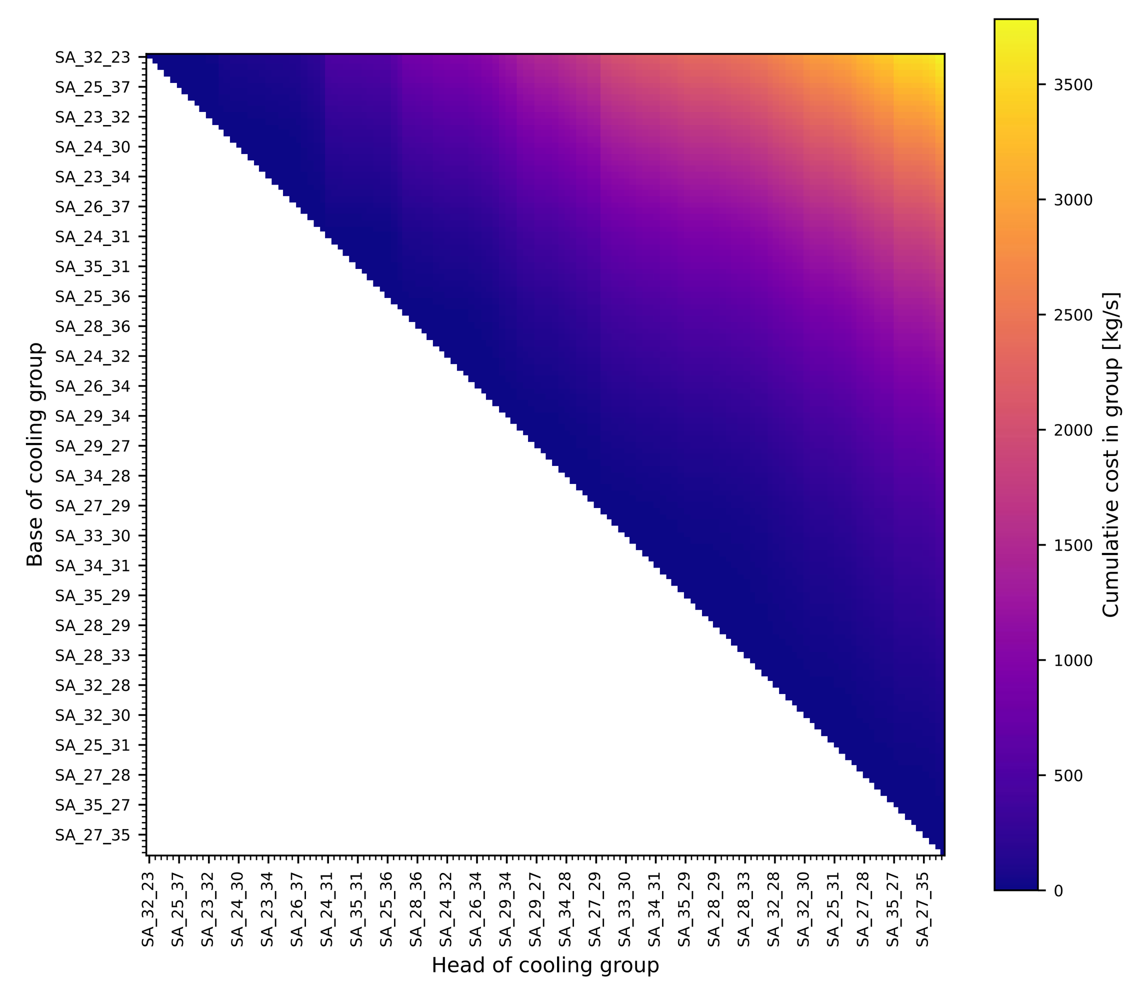
The goal: *optimize a constrained coolant mass flow rate distribution among the fuel assemblies.*

The constraint:
- Peak cladding temperature (PCT) smaller than threshold value, with quantified uncertainties
- Total mass flow rate fixed by Balance-of-Plant

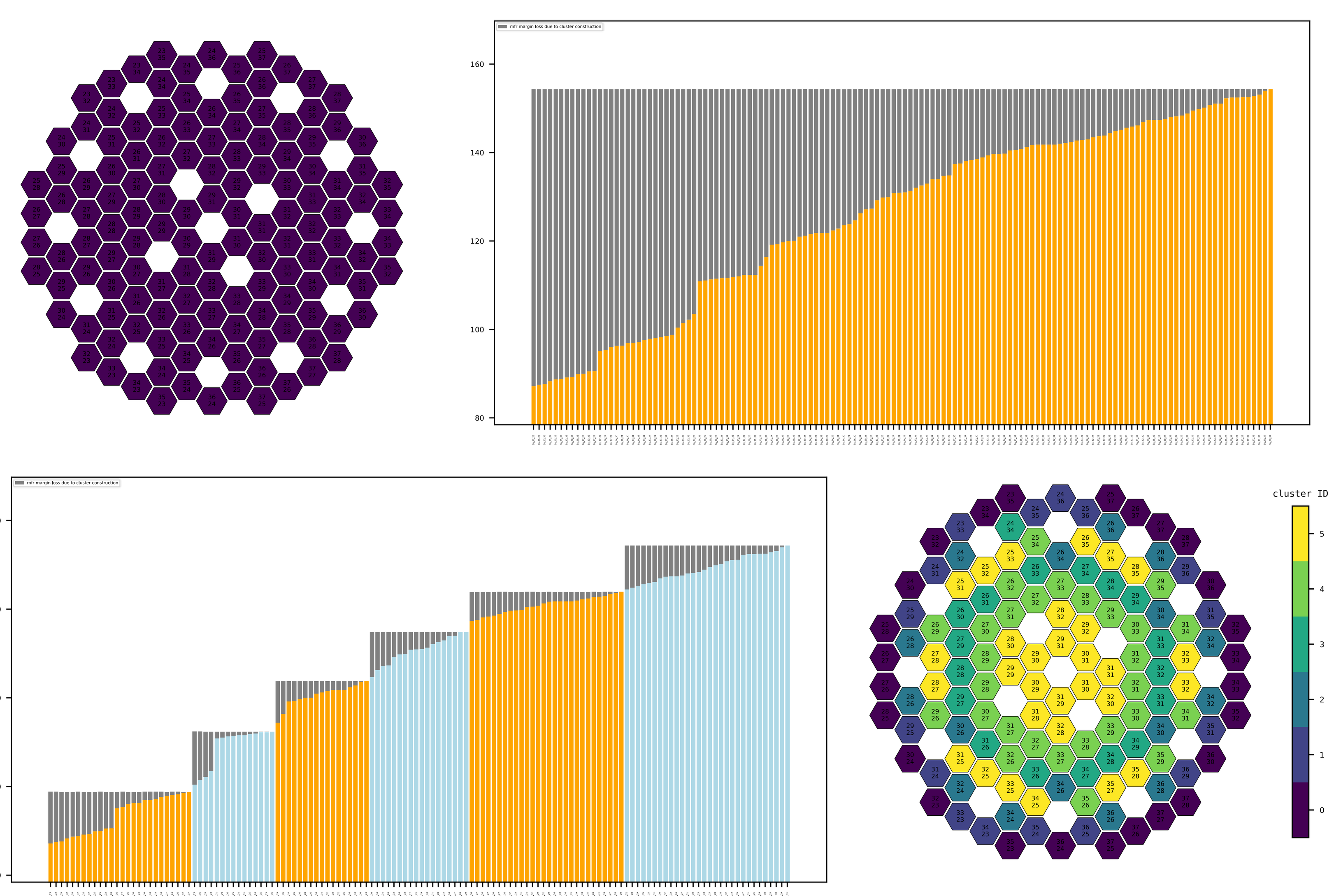
The input data:
- Core description (geometry and composition)
- Med files with core-wise pin power distribution (1+)
- Thermal-hydraulic parameters

The libraries (from MEDUSA):
- coreAssemblies: geometry handling
- coreThermalHydraulic: sub-channel TH calculations

Step 1: thermal-hydraulic core characterization
- For all available time instants and for each fuel assembly (FA), a value of mass flow rate ($\dot{m}$), leading to PCT, is computed
- For each FA, the maximum value of $\dot{m}$ is selected. This is the minimum $\dot{m}$ that must be fed to respect the peak cladding temperature
- FAs are ranked for increasing values of the peak $\dot{m}$



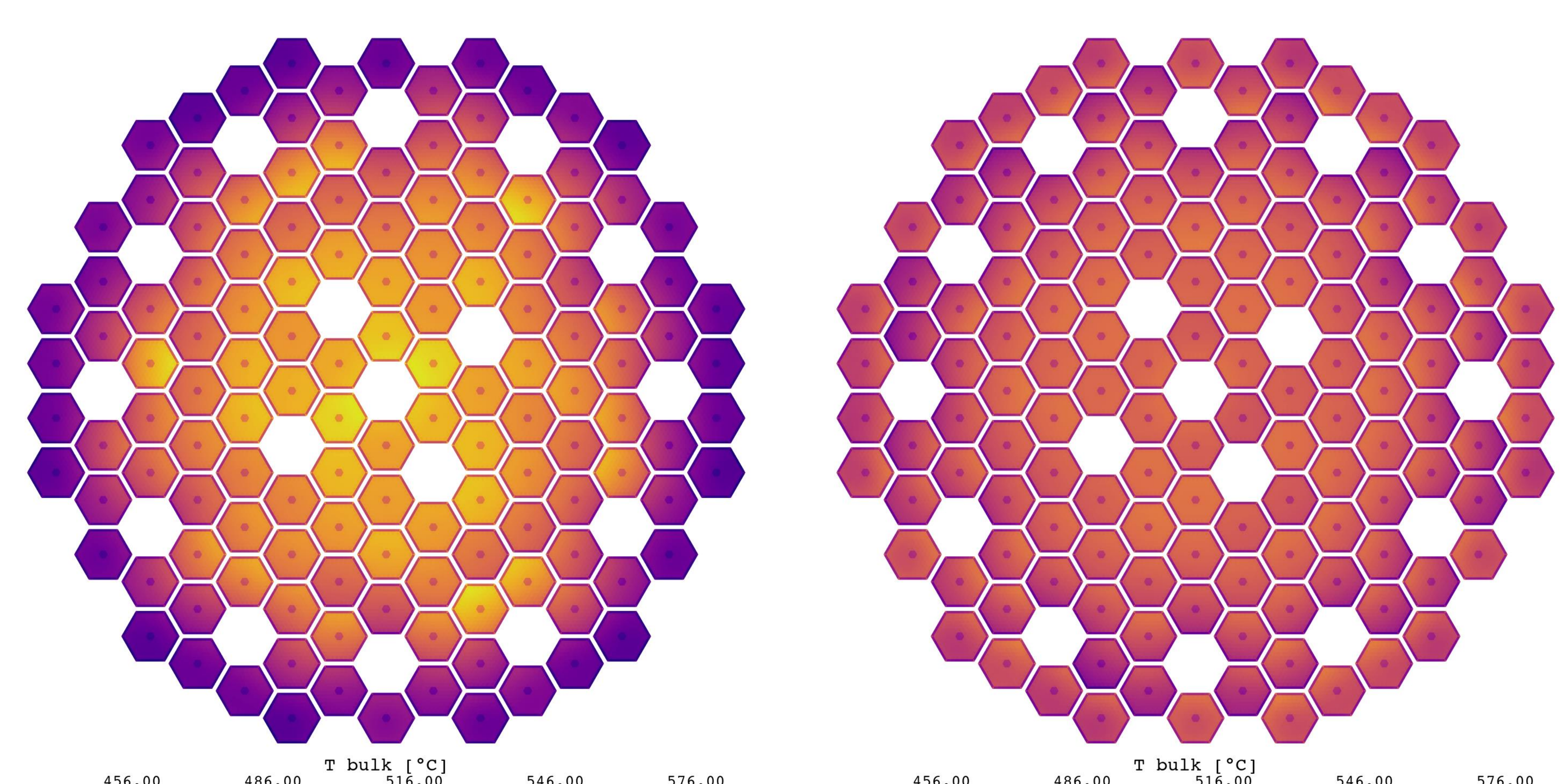
Visualization of the cost matrix for the calculation of a clustering cost, given the base and the head of a cooling group



Visualization of the clustering cost for the case of 1 and 6 cooling groups for the ALFRED reactor, together with the distribution of FAs into cooling groups

Step 2: clustering
- Given the $\dot{m}$ values of the characterization, in a cluster of n assemblies, each FA is fed with the $\dot{m}$ of the assembly with the peak value of $\dot{m}$ (cost of the configuration)
- Given N clusters, minimize the cost of the configuration (traveling from bottom FA up to top FA with N steps in the cost matrix)

Step 3: Optimization
- The $\dot{m}$ margin is the difference between the available $\dot{m}$ and the clustering cost
- The margin is redistributed, among clusters, using one or more rules (minimize pressure losses, minimize temperature gradients, ...)



Comparison of core-wise sub-channel bulk temperatures, at the end of active height, in the case of 1 and 6 cooling groups for the ALFRED rector. The temperature range is reduced: [466; 550] vs [456; 576]

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