Project 2 discussion

Various strategies were used by different students to obtain a design with a small S. For this system, some simple strategies actually work very well. (A good strategy should lead to systematic reduction of S at every step.) See reference solutions for some examples.

As an example of a simple strategy (related to the reference solutions), let's fix side pipe 3 and only adjust the other pipes. From the outcome of the first run in Task 1, use either the MFR of pipe 3 or the average of MFR of all 5 pipes (i.e., the "M" in the problem statement) as the "target" MFR we wish to obtain for all pipes. Denote it as M_{target}. Assuming that the outgoing velocity for each side pipe does not change much with an incremental change in the diameter of the pipe, we adjust the diameter of each pipe by $A_{new}/A_{old} = M_{target}/m_{old}$, where A is the cross-sectional area of the opening of the pipe, and m is the MFR of the individual pipe. Since A is proportional to D^2 where D is diameter of the pipe, we have $(D_{new})^2 = (M_{target}/m_{old})(D_{old})^2$. This design can be used to perform a new run, then the process is repeated using the outcome of the new run, and so on. As shown in the reference solutions, this leads to a monotonic decrease in S which falls below 0.01 in just a few steps.