Parallel session topic: *Fuel cells* **# B.2.2**

A hybrid serpentine-interdigitated flow channel geometry for fuel cells

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fuel cell; flow channel; simulation

Impact statement
While a proposal, the new flow channel geometry may bring long seeked improvements to fuel cell devices by tuning only one cell component. In addition, it may further corroborate a mixed computational-experimental approach based on device analogues, allowing fuel cells to be studied and improved at a much lower cost.

Highlights
Reaction utilization comparable to interdigitated. Pressure drop comparable to serpentine. Flow field may suggest good water removal. Potential for optimization. Device independent.

Abstract
Fuel cells have impressive potential for decarbonization and as high efficiency power sources, however many challenges have yet to be addressed for large scale deployment and uptake. Among the many noteworthy lines of research underway, investigating the best flow field in a given device has been carried a number of times, with perhaps limited success regarding performance improvement. As a possible final attempt to look over such matters individually, from the component point of view, we propose yet another flow channel geometry for small-scale fuel cells, in particular polymer electrolyte fuel cells (PEFCs). The proposed geometry incorporates elements from the two most studied geometries, namely single serpentine and interdigitated. The rationale is that serpentine channels have large pressure drop, thus aiding in water removal, while interdigitated promises to deliver large quantities of reactants to the catalyst. However both seem to fail where the other excels, and thus devices are left to compromises. The new geometry, as well as its inspirations, are simulated in a previously validated computational model, further improved and with high spatial resolution, of a prototype PEFC cathode. The model is isothermic, non-electrochemical and disregards water, as the experimental system. However it has been shown to be useful when studying PEFCs, and a secondary goal of this work is to corroborate this. Comparing simulation results between geometries, it is seen that the hybrid geometry does inherit the characteristics of interest, i.e. high reactant utilization and pressure drop, suggesting it may be of use in real PEFCs. Finally, a niche application is proposed based on the reaction rate distribution of the hybrid geometry.