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Towards a differentiable sampling ECAL model with optimal absorber material distribution

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The distribution of material in sampling electromagnetic calorimeters has a direct impact on the energy resolution that they can achieve. R&D calorimetry efforts that are inspired for future collider detector concepts aim for the best energy performance given constraints, e.g. mechanical and cost. We address the energy resolution optimization in the case of a Silicon-Tungsten Electromagnetic Calorimeter (SiW-ECAL) prototype where a particle impacts at different energies, a case study for which we have prepared Geant4 simulations. The first step we are taking towards optimizing the Tungsten (absorber material) distribution for a fixed amount and number of layers is to implement a generative (differentiable) model that can replace the available simulated datasets in the optimization pipeline and is able to interpolate in the input parameter space; this will allow for an automatically differentiable ECAL model. We show and discuss our on-going work in the generative models explored for such purpose and the prospects for including them in a more general optimization scenario (i.e. adding further constraints and figures of merit, besides the energy resolution), as well as the differences with respect to more traditional optimization approaches.

Primary authors: Mr VADHERA, Shivay; Dr JIMENEZ MORALES, Fabricio Andres; Dr BOUDRY, Vincent

Presenter: Mr VADHERA, Shivay

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