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Algorithmic differentiation in a granular calorimeter

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Algorithmic differentiation (AD) allows to compute derivative of computer-implemented function. Among other applications, such derivatives are useful across domains for gradient-based design optimization and parameter fitting. In the context of high-energy physics, AD may allow to systematically improve detector designs based on end-to-end simulations of detectors. We have recently added an important building block to this end by releasing a forward-mode differentiated version of the Geant4 toolkit for the simulation of the passage of particles through matter, validating derivatives for a simple sampling calorimeter made up of square layers of absorber and gap material.

In this poster, we use the differentiated version of Geant4 to simulate a calorimeter made up of a 100x100x100 grid of sensitive voxels. This allows to validate the derivatives investigated in our previous study, namely, derivatives of energy depositions with respect to the primary energy of incoming particles and geometric lengths of the detector design, in this more complex setup.

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