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Radio morphing: towards a full parameterization of the radio signal from air-showers

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Over the last decades, radio detection of air showers has been established as a
promising detection technique for ultrahigh-energy cosmic rays and neutrinos. Very large or dense antenna arrays are necessary to be proficient at collecting and understanding accurately these particles. The exploitation of such arrays require to run massive air-shower simulations to evaluate the radio signal at each antenna position, taking into account features such as
the ground topology. In order to reduce this computational cost, we have developed a full parametrisation of the emitted radio signal on the basis of generic shower simulations, called radio morphing. The method consists in computing the radio signal of any air-shower by i) a scaling of the electric-field amplitude of a reference air shower to the target shower, ii) an isometry on the simulated positions and iii) an interpolation of the radio pulse at the
desired position. This technique enables one to gain many orders of magnitude in CPU time compared to a standard computation. In this contribution, we present this novel tool, explain its methodology, and discuss its application extents. In particular, radio morphing will be a key element for the simulation chain of the Giant Radio Array for Neutrino Detection (GRAND) project, that aims at detecting ultra-high-energy neutrinos with an array of 200 000 radio antennas in mountainous regions.

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