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A Kalman Filter approach for track reconstruction in a neutrino telescope

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In high energy neutrino telescopes, the detection principle relies on the detection of Cherenkov light emitted from an up-going muon induced by νμ that have penetrated the Earth.
At the muon energy range of interest in astrophysical search (namely from about 100 GeV to about 1 PeV), the electromagnetic showers accompanying the muon track generate Cherenkov light emitted within a few degrees of the same cone as the light from the primary particle. Furthermore, since photon scattering in the water, the measurement is affected by non-Gaussian noise. As a consequence, the reconstruction of tracks in underwater Cherenkov neutrino telescopes is strongly complicated.
Moreover, environmental background originates large noise counting rate. In an undersea neutrino detector, in fact, the decay of radioactive elements in the water, mainly the β-decay of potassium isotope 40K, generates electrons that produce Cherenkov light leading an isotropic background of photons. These photons may compromise the hit pattern of a neutrino induced event, and consequently the event reconstruction, even when coincidence methods significatively reduce the contamination.
As result, track reconstruction deal with a non-linear problem with a non-Gaussian measurement noise. A method for track reconstruction in a km3 underwater neutrino telescope, based on Gaussian Sum Filter algorithm to take into account non-Gaussian process noise, is presented.

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