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PENELOPET, A monte carlo-based application for tomography based on PENELOPE

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PENELOPE is a code for Monte Carlo simulations of the transport in matter of electrons, positrons and photons with energies from a few hundred of eV to 1 GeV. It is robust, fast and very accurate, but it may be unfriendly for people not acquainted with the fortran prograaming language.

We have developed an easy to run application that allows complete simulations for PET and SPECT with PENELOPE. Very sophisticated simulations can be prepared by modifying just a few simple inputs files. The output data gets ready for post-analisys with differents levels of post-processing and can be analized with the prefered programming language.

Parameters of the input files are scanner geometry and composition. The same for the objects to scan, source activity and isotope. A number of options, such as simulation of positron range, photons non-collinearity and scanner motion can be easily selected from the input file. It has also been implemented the posibility of limiting the number and kind of particles involved in the simulation. For instance, it can be choosen to simulate only the initial gamma photons (511 keV and others).

The output files can have three levels of post-proccesing. In the lowest one, all the information about each interaction is kept for further analysis. At an intermediate level, just the singles events with the information needed for the analysis is stored. The possibility of pile up and cross talk are taken into acount. The third and highest level of proccessing stores the coincidence counts in a typical LIST file but with information about pile up, scatter, randoms and autocoincidences events from the simulation. A more elaborated analysis is possible if the user writes his own code.

We get better performance with this applicattion that with other SPECT and PET dedicated codes such as SIMSET and GATE. Accurate simulations results in a reduced period of time are obtained.

We made realistic simulations to validate the code against an actual continuous rotating PET scanner and a full ring PET scanner. Detector efficiency, sensitivity, spatial resolution, scatter and random fraction and energy spectrum are some of the parameters that we have measured to complete the validation. We can conclude that this is a good application for PET and SPECT simulations.

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