Optimizing the selection of step-size parameters

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The new transport mechanics in EGS5 allows for longer electron transport step sizes and hence shorter computation times than required for identical problems in EGS4. But as with all Monte Carlo electron transport algorithms, there are still theoretical limits on the maximum allowed transport step sizes, and certain classes of problems can exhibit step-size dependent behavior even when operating within the prescribed limits. Additionally, despite the enhanced accuracy of EGS5 at long steps, for a variety of reasons, optimal selection of step size parameters in EGS5 may actually be more problem dependent than with EGS4. First, because of the de-coupling of multiple scattering and continuous energy loss in the dual random hinge transport mechanics of EGS5, there are two independent step sizes in EGS5, one for multiple scattering and one for continuous energy loss, and each exhibits different behavior on problem results. Second, whereas EGS4 used a single value of fractional energy loss (ESTEPE) to determine step sizes at all energies, EGS5 permits the fractional energy loss values used to determine both the multiple scattering and continuous energy loss step sizes to vary with energy, thus leading to a total of 4 fractional energy loss values which the user may specify. Finally, in most Monte Carlo programs, including EGS4, electron transport is stopped at boundaries, and so user geometry often provides **de facto** step size limits. Because EGS5 permits transport across region boundaries, however, EGS5 can sometimes exhibit step-size dependence in problems where it would be masked by user geometry in EGS4. In this paper we investigate the theoretic limits of the new EGS5 transport mechanics and describe the implementation of the step-size control mechanism. We also examine a series of problems in which step-size dependencies might be seen in EGS5, and we summarize a general prescription for optimizing step-sizes for various classes of problems.