Fast ray-tracing for real-time positioning applications using numerical weather models

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The atmospheric excess path delay is a major contributor to the error budgetof satellite positioning applications. Numerical weather models areundergoing an improvement in spatial resolution, what allows compensation of troposphere propagation errors by ray-tracing through three dimensional meteorologic fields. The location of the grid-points follows the needs of meteorologists rather than permits efficient ray-tracing algorithms. Thus we present a method that can resample and refine the huge data-cubes onto regular grids using a sophisticated and fast method, developed at the National Institute of Information and Communications Technology (NICT). Once these data has been generated ray-tracing algorithms follow analytic expressions, what allows computation of atmospheric excess path delays in real-time for many users using an off-the-shelf PC. Since numerical weather models are provided actually with a minimum spacing of 3 hours we also present an efficient time interpolation algorithm. By the usage of our algorithms we demonstrate the reduction of position errors using the Global Navigation Satellite System.