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Ionospheric electron number density volumetric reconstruction with ADS-B: a new method to image the ionosphere.

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The proposed launch of CanX-7, carrying a space-borne ADS-B receiver developed by the Royal Military College of Canada will create a unique opportunity to study the modification of the 1090 MHz radio waves following propagation through the ionosphere from the transmitting aircraft to the passive satellite receiver. Our previous work has successfully demonstrated that ADS-B data is feasible as input to reconstruct two dimensional electron density maps of the ionosphere using techniques from computerized tomography. The goal of this work is to extend the model and reconstruct three dimensional (3D) electron density distributions to evaluate the feasibility of CT reconstruction in 3D with temporal variation. The data used as input for reconstruction was modelled using ray-tracing techniques for aircraft distributions from actual worldwide ground-based ADS-B data to a satellite orbit simulated in Satellite Tool Kit, and repeated for multiple satellites forming an arbitrary constellation with global coverage. Ray-tracing determined the characteristics of individual waves, including the wave path and the state of polarization at the satellite receiver. The modelled Faraday rotation was determined and converted to total electron content along each ray-path. The resulting total electron content was used as input for computerized ionospheric tomography using the algebraic reconstruction technique. This study concentrated on meso-scale structures 100–1000 km in horizontal extent. The primary scientific interest of this work is to show the feasibility of a new method to image the ionosphere and obtain a better understanding of magneto-ionic wave propagation.

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