Efficient Integral Equation-Based Propagation Modelling for Radio Coverage Prediction

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This study exhaustively explores integral equation based propagation modeling techniques for electromagnetic waves and tries to improve upon the existing models by providing a method that includes the backscattering electric field as well. All the methods discussed have the computational complexity of the order of the square of the number of integral intervals (groups in FExM) as opposed to the basic algorithm (Exact method) which has a computational complexity of the order of the cube of integral intervals. It is explained that how these modeling methods can be used in conjunction with a Radio Environment Map (REM) aided Cognitive Radio Network (CRN) to implement the 5G efficiently by enabling the Dynamic Spectrum Access (DSA), to get past the limitations of traditional static spectrum allocation. The predictions are made using all the models on the most commonly used and gently undulated 'Hadsund' terrain profile and on more rugged 'German' terrain profile. All the models work equally well on the 'German' terrain profile as they did on the 'Hadsund' terrain profile. The predictions made using these models are in sync with that of the state of the art Okumura-Hata model. This study als0 addresses the problem of localization of the non-cooperative transmitter using signal strength measurements based on the Reciprocity Theorem and produces the results accurate to around 147 meters, upon a random selection of the locations of three pair of transceivers. This localization method is a huge improvement over existing signal strength measurements based methods in terms of computational complexity, with highly accurate results. This study also provides a detailed roadmap for the future scope of improvement on the limitations of the study such that sufficient accuracy and execution times can be achieved.