Radio Propagation in Fire Environments

by

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Abstract

Radio propagation in the presence of fire is known to be problematic to communications. In this thesis we use both experimental and theoretical approaches to examine and understand radio propagation in fire environments. Propagation is examined for three small scale fires with broadband equipment operating from 50MHz to 1GHz. Results for line of sight propagation show a strong interaction of fire with electromagnetic propagation. The next section develops electromagnetic modelling of the fire environment. A model of the combustion induced plasma is developed, as well as a refractive index model of the surrounding atmosphere of a fire. Simple propagation calculations are undertaken, using the developed fire models, to provide an intial understanding of propagation in fire environments. The next portion of the thesis considers propagation using a more rigorous electromagnetic simulation technique. A modified Finite Difference Time Domain method is presented and is utilised to examine three dimensional propagation in the small scale fire experiments. The outcome is a more solid understanding of propagation and the contributing factors. The last portion of the thesis is the application of the above electromagnetic modelling and simulation methods to bushfire scenarios. Various scenarios that are problematic to radio communication are examined. Discussion and recommendations are made concerning radio communication frequency selection and considerations for propagation in fire environments.

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Statement of Originality

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