ENGL 221 Case Study

From: Geoff Kamehameha [G.Kame@nasa.gov]
Date: April 19, 2019
To: NASA ESD Research Team 7
Subject: Experiment #03059 Theoretical Basis
Attachments: friss.equation1.pfd; friss.equation2.pdf; db.watts.convert.pdf

Hello Team,

Please find my write-up of our report's theoretical basis below. If you have questions, comments, or concerns please don't hesitate to email me.

Theory

The principle theory tested across experiments is the Friis Transmission Equation (FTE) (Equation 1). The FTE predicts that broadcasted signals will lose strength as the distance between the transmitter and receiver increases. The FTE quantifies the loss of signal strength with change in distance (Friis Equation & Transmission, 2018).

Equation 1: Friss Equation

$$\frac{P_r}{P_t} = G_r G_t \left(\frac{\lambda}{4\pi R}\right)^2$$

In the FTE, P_r describes the power at receiving antenna; P_t describes the power at transmitting antenna; $G_r G_t$ describes the gain of receiving and transmitting antennae; λ describes wavelength; and R describes the distance between antennae. Equation 1, shown above, is linearly scaled. Given the significance of small changes in signal strength, a logarithmic scale may also be appropriate (Equation 2). All experiments utilized the logarithmic scale.

Equation 2: Logarithmic Friis Equation

$$\mathrm{P_r} = \mathrm{P_t} + \mathrm{G_r} + \mathrm{G_t} + 20\log\left(\frac{\lambda}{4\pi \mathrm{R}}\right)$$

Finally, calculating RSSI in the experiments requires converting dB to watts (Equation 3).

Equation 3: Converting dB to watts

$$10\log\frac{\mathrm{dB}}{10}$$

I think that just about covers it. What's there should be good-to-go, but you might want to make sure the equation images hold up. I'm not really all that confident in how I've formatted those equations.

Thanks,

Geoff