Skew-Laplace model parameters for radio-frequency tomography experiments

Nannuru Santosh, Yunpeng Li, Mark Coates and Bo Yang

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Introduction

This technical report serves as a supplementary document for the paper [1], providing further details about the experiments and the model fitted parameters. In particular, we detail the skew-Laplace parameters that were obtained by combining the data from different experiment sites. These parameters were used in the various tracking algorithms to obtain the results presented in [1].

Description of experiments

Multiple experiments are performed at three different experiment sites and each experiment repeated multiple (8-10) times. The first site is in the Trottier Building at McGill University. An area of $8m \times 8m$ was monitored by 24 sensor nodes. A concrete pillar lies within the network. The second experiment site is the Computer Networks Lab of McGill University. An area of $9m \times 9m$ is monitored by 24 sensor nodes. Numerous desks and chairs are present within the network and there are walls just outside. The third experiment site is in the Beijing University of Posts and Telecommunications (BUPT), China. Data was collected in a completely through-wall environment using 28 nodes covering a $5.2m \times 6.7m$ region.

Data is collected at each of the three sites when a single target is moving inside the network and classified into training and testing data. Training data from all the experiments is combined and used to obtain model parameters.

Model parameters

The skew-Laplace distribution is used to model the observed RSS attenuation in [2] and can be expressed as

$$\begin{aligned} f(s; a, b, \psi) &= \frac{ab}{a+b}\, e^{-a(\psi - s)} \text{ if } s \leq \psi \\ &= \frac{ab}{a+b}\, e^{-b(s-\psi)} \text{ if } s > \psi \end{aligned}$$

Here a and b represent the one-sided decay rates of the distribution for values less than or greater than the mode ψ. In the original model the skew-Laplace distribution parameters are modeled as piecewise linear functions of the fade level (F). Table 1 details the linear fit parameters obtained using the training data described above. The parameters depend on whether the target is present on the Line of Sight (LOS) or away from it, Non Line of Sight (NLOS).

In [1] the parameters of the skew-Laplace distribution were observed to depend on λ which is a measure of the distance between the target location and the link. Table 2 details the modified skew-Laplace model parameters as linear functions of λ.

	Parameter		
Target	a	b	ψ
LOS	-0.0005F+0.31	-0.008F+0.63	-0.19F-0.69
NLOS	0.09F+1.81	0.14F+2.59	-0.01F+0.09

Table 1: Parameter values for fitted skew-Laplace distributions as linear function of fade level (F).

	Parameter		
λ	a	b	ψ
$0 < \lambda \leq 0.2$	0.78λ+0.41	1.40λ+0.24	-1.47λ+0.35
$\lambda > 0.2$	1.29	1.08	-0.01

Table 2: Parameter values for fitted skew-Laplace distributions as linear function of λ.

References

[1] S. Nannuru, Y. Li, Y. Zeng, M. Coates, and B. Yang, "Radio frequency tomography for passive indoor multi-target tracking," 2012, submitted to IEEE Trans. Mobile Computing.

[2] J. Wilson and N. Patwari, "A fade level skew-Laplace signal strength model for device-free localization with wireless networks," *IEEE Trans. Mobile Computing*, vol. PP, no. 99, 2011.