Signal detection theory and vestibular perception: III. Estimating unbiased fit parameters for psychometric functions

Experimental Brain Research

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Online Resource 2

Since the biased-reduced $\hat{\sigma}$ estimates in Table 2 of the paper are positively biased, we can use a scale factor (α) to improve both the accuracy (reduced bias) and precision (lower variance) of our estimates. If μ is set to $k\sigma$, where k is a constant, the expected BRGLM $\hat{\sigma}$ bias ($\mathrm{E}[\hat{\sigma}] - \sigma$) scales linearly with σ, but the size of the scaling increases non-linearly with increasing values of $|k|$. Fig. S2 shows the expected BRGLM $\hat{\sigma}$ bias normalized by σ, $(\mathrm{E}[\hat{\sigma}] - \sigma)/\sigma$, for a 3D/1U staircase with $n = 25$ as a function of $|k|$, where $\mu = k\sigma$. We can fit the simulated expected percent bias to a 4th order polynomial such that:

$$(\mathrm{E}[\hat{\sigma}] - \sigma)/\sigma = -0.030|k|^4 + 0.062|k|^3 + 0.254|k|^2 - 0.038|k| + 0.085$$

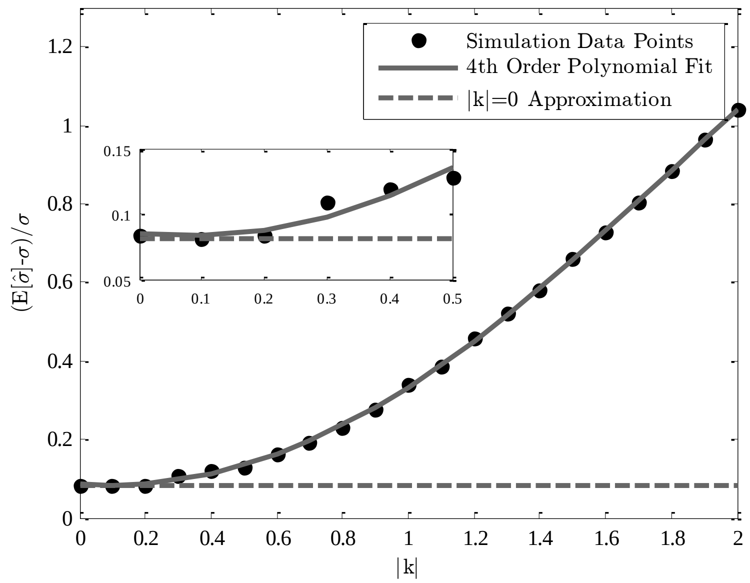

Fig. S2 The expected BRGLM $\hat{\sigma}$ percent bias for a 3D/1U staircase with $n = 25$ as a function of $|k|$, where $\mu = k\sigma$

We note that for small k, which, in our experience, includes the majority of normal vestibular data, the expected percent bias is nearly constant and so using the value (0.085) at $|k| = 0$ in this range provides a good approximation. In this case α is constant and is equal to $(1 + ((\mathrm{E}[\hat{\sigma}] - \sigma)/\sigma)|_{k=0})^{-1} = (1.085)^{-1} = 0.922$. If the range of $|k|$ were greater we could use the 4th order polynomial fit to calculate α. From the BRGLM fit we would get an estimate of $\hat{k}$ equal to $\hat{\mu}/\hat{\sigma}$. Using the 4th order polynomial, we could then estimate the expected percent bias and α would be equal to $(1 + ((\mathrm{E}[\hat{\sigma}] - \sigma)/\sigma)|_{\hat{k}})^{-1}$.