Optimizing data acquisition for scaling methods, particularly MLCM

Bachelor Thesis Exposé
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Trial: Which side does the participant perceive as brighter?
Perceptual Encoding Function

• Empirical estimation of brightness perception in our visual system

• Transfer function $f(x)$:
  
  • $x$: Luminance and Context
    
    • Luminance: 10 Levels between 0 and 1
    • Contexts: "On white" and "On Black"
  
  • $f$: $x$ to perceived brightness $R$
Percentage of a participant choosing either x-axis-stimuli or y-axis-stimuli.

1: X-Axis
0: Y-Axis
15 Repeats
Maximum Likelihood Conjoined Measurement (MLCM)

- Used to estimate perceptual scales
  - Models relationship between stimulus and response
  - Luminance and perceived brightness
  - Maximum likelihood

- Perceptual scales represent Perceptual Encoding Function
  - How the illusion affects our perception
  - Response to a unique stimulus
The Problem

• Trials accumulate
• Some trials have consistent results
• Consistent results aren’t precious
• Consistent results take up time and energy

\[ \text{Unique Trials} = \frac{20 \times (20 - 1)}{2} \]

\[ 10 \text{ Luminance Levels} \times 2 \text{ Contexts} - \text{Itself} \]
Research Question:

Can we reduce the amount of trials and consequently the experiment’s duration, for a fixed set of unique stimuli, without impacting the quality of the encoding function recovered using MLCM?
Proposed Method 1:

Remove trials with luminance difference of >0.2 for same context

Remove trials with luminance difference of >0.5 for different context

Cut down Matrix
1560/2850 Trials
45.3%
Preliminary results Static

Static cut down:
- 45.3% efficiency increase
- No decrease in accuracy (<0.4%)
How do actual results look like?
What else can be done?

- Fine tune static method
- Use other methods
- Vary the ground truth function
- Vary noise levels
- More Luminance Levels
- More Contexts (Size of Targets)