Linear Data Chapter 4

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1. If noise-canceling headphones estimate $\vec{s}$ to be the background sound, what do the headphones generate to cancel out the noise?

2. Explicitly compute by hand (with work shown) the following Frobenius inner products

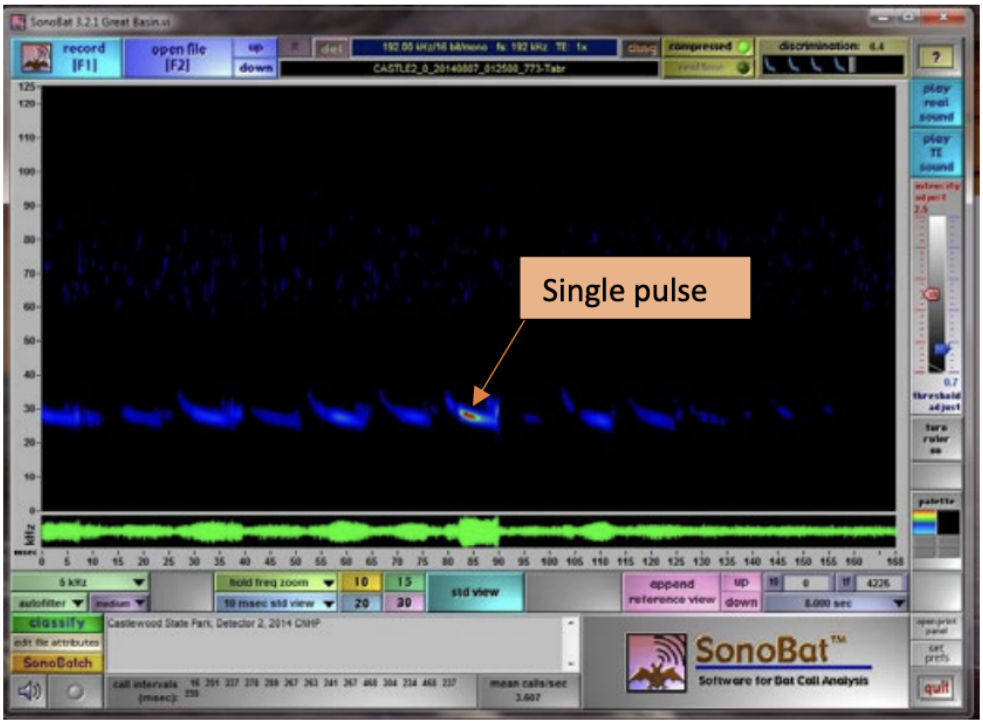
   (a) $\left\langle \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}, \begin{pmatrix} 4.56 & 3.12 & -1 \\ 10.9 & 0 & 5 \end{pmatrix} \right\rangle_{Fro}$

   (b) $\left\langle \begin{pmatrix} 1 & -2 \\ 0 & 1 \end{pmatrix}, \begin{pmatrix} -1 & 1 \\ 5 & 2 \end{pmatrix} \right\rangle_{Fro}$

3. Give an example of an application of hyperspectral imaging.

4. In 2017, the City of Fort Collins ran a study[1] to better understand bat populations in the city's parks and natural areas. The screenshot of a spectrogram of bat calls at a location in Fort Collins shown below appeared in that study.

[1]Source: `https://www.fcgov.com/naturalareas/files/fort-collins-natural-area-bat-surveys-report_2017opt.pdf`, accessed 2024.02.18



- Explain what kind of information a spectrogram tells you about data. Discuss why that might be pertinent in the study of bats.
- Explain how a spectrogram relates to one or more of the basic linear algebra operations (scalar multiplication, vector addition, linear combination, inner product).

5. Using Python/Jupyter or Matlab/Matlab Live Script, perform the following:
   - Load two song vectors of the same length $\vec{x}$ and $\vec{y}$, either from the file provided during the lab or your own.
   - Set $\vec{z}$ to be a linear combination of $\vec{x}$ and $\vec{y}$ where the coefficient for $\vec{x}$ makes it quieter and the coefficient for $\vec{y}$ makes it louder.