

SGN-14007 Introduction to audio processing - Exercise 6

February 19, 2018

Return deadline: 28.2.2018, at 12:00 in Moodle.

Math Question

(0.25 points / item, total 1 point)

In this exercise, you see how features react to different cost functions, that are used e.g. in dynamic time warping, or, slightly modified, as similarity functions between two features.

Let's assume you have two signals $x(t)$ and $y(t)$. You are time-aligning the signals using features obtained from these signals. Your feature dimension is three and let's assume it represents the magnitude spectrum. The first feature vectors of two signals are $\mathbf{x}_1 = [1, 3, 2]^T$ and $\mathbf{y}_1 = [0.5, 1, 2]^T$, where $[\cdot]^T$ denotes transpose.

- (a) What is the cosine-based cost between \mathbf{x}_1 and \mathbf{y}_1 ? Cosine cost function is defined here as

$$d(\mathbf{x}, \mathbf{y}) = 1 - \frac{\mathbf{x}^T \mathbf{y}}{\|\mathbf{y}\| \cdot \|\mathbf{x}\|} \quad (1)$$

- (b) What is the Euclidean distance between \mathbf{x}_1 and \mathbf{y}_1 ? Euclidean distance is

$$d(\mathbf{x}, \mathbf{y}) = \|\mathbf{x} - \mathbf{y}\| \quad (2)$$

- (c) If you multiply \mathbf{x}_1 with 2, does the cosine distance value change? Does the amplification of signal $x(t)$ or $y(t)$ affect this cost?
- (d) If you multiply \mathbf{x}_1 with 2, does the Euclidean distance value change? Does the amplification of signal $x(t)$ or $y(t)$ affect this cost?

Write your answers in file `exercise6.txt`.

Programming Exercise

(1 point)

In this exercise, you will get familiar with different types of features for music signal processing and get to use them in the task of seeking an optimal temporal alignment between two short melodies.

- (a) Download the `exercise_6_a.py` and two accompanying audio files (`t2.wav` and `t1_fast.wav`) from Moodle to your local folder 'sgn2017/exercise6'. Edit the None and missing parts in the code file. Answer the questions in the exercise file and write the answers as `exercise6.txt` for submission.

Return two files: the python code with your solutions (single file named `exercise6.py`), and the answers to exercise questions 1 and 2 in file (`exercise6.txt`) to Moodle. Please don't forget to *click Submit Assignment link* once you have uploaded the final version. Do not attach any other files.