

Missing audio detection

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1 Problem definition

Let be a and b two nearby recorders capturing the same signal $s(t)$. We would expect that :

$$a(t) = s(t) + n_a(t) \quad (1)$$

$$b(t) = s(t) + n_b(t) \quad (2)$$

Where n denotes the noise function.

In reality, the recorders might briefly stop working for some time, resulting in gaps in the recordings.

Let f_a be the activation function of a , i.e. :

$$f_a(t) = \begin{cases} 1 & \text{if } a \text{ is recording at time } t. \\ 0 & \text{otherwise.} \end{cases} \quad (3)$$

Then :

$$a(t) = s\left(\int_0^t f_a(s)ds\right) + n_a\left(\int_0^t f_a(s)ds\right) = s(t_a) + n_a(t_a) \quad (4)$$

Where :

$$t_a(t) = \int_0^t f_a(s)ds \quad (5)$$

(same for b).

The experimenter only has access to $t_a \mapsto a(t_a)$ and $t_b \mapsto b(t_b)$.

From the data, we would like to estimate $M(a)$, the fraction of audio missed by the recorder a defined as :

$$M(a) = 1 - \frac{\int_0^T f_a(t)f_b(t)dt}{\int_0^T f_b(t)} \quad (6)$$