Theory

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1 Signal Processing

Matched Filtering Detect the presence of a template in the unknown signal. Want to maximize SNR. Basically inner product.

SNR

$$\text{SNR} = \frac{P_{signal}}{P_{noise}} \Rightarrow \text{SNR} = \frac{E[S^2]}{E[N^2]}$$

2 Bayesian Statistics

Parameters are treated as random variables that can be described with probability distributions. Often denoted by θ

Probability is our degree of belief.

Prior Distribution for θ A prior distribution is a **mathematical expression of our belief** about the distribution of the parameter. E.g. the prior distribution for θ might be uniform.

Likelihood Functions Probability distributions quantify the probability of the data for a given parameter value (that is, $P(y|\theta)$), whereas a likelihood function quantifies the likelihood of a parameter value given the data (that is, $L(\theta|y)$). The functional form is the same for both, and the notation is often

used interchangeably (that is, $P(y|\theta) = L(\theta|y)$). E.g. likelihood function might be binomial.

Posterior Distribution Posterior = Prior * Likelihood

$$P(\theta|y) = P(\theta) * P(y|\theta)$$

3 Bayesian Inference

Bayes Rule

$$P(\theta|x) = \frac{P(x|\theta) \cdot P(\theta)}{P(x)}$$