Detection et Estimation

TP:
Detecttion

Master SISEA

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Chapter 1

Introduction

1.1 Objectif

1.2 Write the log likelihoood funciton $L(A, \phi)$ for a given observation vector

We have the signal

$$x(n) = Acos(2\pi f_0 n + \phi) + w(n) \tag{1.1}$$

The non deterministic part of the signal is the noise. A White Gaussian noise with variance σ^2, wich is common in many fields. So the log-likelihood function is evaluated in function of this noise with the next expression.

$$w(n) = x(n) - Acos(2\pi f_0 n + \phi) \tag{1.2}$$

The WGN distributions are iid so

$$P(w(n)|A, \theta) = \prod_{n=0}^{N-1} P_w(w(n)) \tag{1.3}$$

So the log-likelihood function $L(A, \phi)$ is

$$L(A, \phi) = logP(w(n)|A, \theta) \tag{1.4}$$

$$L(A, \phi) = log \prod_{n=0}^{N-1} P_w(w(n)) \tag{1.5}$$

$$L(A, \phi) = \sum_{n=0}^{N-1} logP_w(w(n)) \tag{1.6}$$

$$L(A,\phi) = \sum_{n=0}^{N-1} log(\frac{1}{\sigma\sqrt{2\pi}} \exp\left[-1/2(\frac{x(n) - Acos(2\pi f_0 n + \phi) - \mu}{\sigma})^2\right] \tag{1.7}$$

$$L(A,\phi) = \sum_{n=0}^{N-1} B + ([-1/2(\frac{x(n) - Acos(2\pi f_0 n + \phi) - \mu}{\sigma})^2]a \tag{1.8}$$

1.3 Show that the maximun likelihood estimators are the solution of the following equations

$$\frac{\partial L(A,\phi)}{\partial A} = \sum_{n=0}^{N-1} (\frac{x(n) - Acos(2\pi f_0 n + \phi) - \mu}{\sigma})(\frac{cos(2\pi f_0 n + \phi}{\sigma}) \tag{1.9}$$

$$\frac{\partial L(A,\phi)}{\partial \phi} = \sum_{n=0}^{N-1} -(\frac{x(n) - Acos(2\pi f_0 n + \phi) - \mu}{\sigma})(\frac{Asin(2\pi f_0 n + \phi}{\sigma}) \tag{1.10}$$

$$\frac{\partial L(A,\phi)}{\partial \phi} = 0 = \sum_{n=0}^{N-1} -(\frac{Ax(n)sin(2\phi f_0 n + \phi)}{\sigma^2} - \frac{A^2 cos(2\phi f_0 n + \phi)sin(2\phi f_0 n + \phi)}{\sigma^2}) = 0 \tag{1.11}$$

$$\frac{\partial L(A,\phi)}{\partial \phi} = 0 = \sum_{n=0}^{N-1} -(\frac{Ax(n)sin(2\phi f_0 n + \phi)}{\sigma^2} - \frac{A^2 cos(2\phi f_0 n + \phi)sin(2\phi f_0 n + \phi)}{\sigma^2}) = 0 \tag{1.12}$$

$$\frac{\partial L(A,\phi)}{\partial \phi} = 0 = \frac{A}{\sigma^2} \sum_{n=0}^{N-1} -(\frac{Ax(n)sin(2\phi f_0 n + \phi) - A^2 cos(2\phi f_0 n + \phi)sin(2\phi f_0 n + \phi)}{\sigma^2}) = 0 \tag{1.13}$$

Chapter 2

Implémentation en MATLAB®

2.1 Estimation de l'information mutuelle

2.2 Conclusion