# Detection and Pattern Recognition

Matrix Computation and optimization : .

Matrix Cookbook , Convex optimization → Online → Google it

Slide 1.0

Introduction

1.1 Signal processing , ML ~~and~~

Slide 1.16.1

1.2 Detection

Baseband - no need to care about carrier.

1.19.1

Binary detection = hypothesis Test

| | bit | radar | witness |
|---|---|---|---|
| *) 2 hypothesis | | | |
| . null hypothesis $H_0$ | $-1$ | no target | not murder |
| . alternative hypothesis $H_1$ | $+1$ | target | murder |

*) unknown true state $H \in \{H_0, H_1\}$

Given :

*) a noisy measurement vector $\underline{x}$

*) a probabilistic signal model for $\underline{x}$ : $p(\underline{x} \mid H_0)$

$p(\underline{x} \mid H_0)$ = prob. density f.n (PDF) of $\underline{x}$ conditioned on $H_0 = H_0$

$p(\underline{x} \mid H_1)$ = . . . on $H = H_1$

*) sometimes a priori prob (prior) about $H_0, H_1$ :

$P(H = H_0)$ , $P(H = H_1) = 1 - P(H = H_0)$

## Notation:

$p()$ for PDF for continuous valued RV

$P()$ for Prob discrete " "

= Probability Mass F.n (PMF)

## Task:

Design a detector $\hat{H}(\underline{x}) \in \{H_0, H_1\}$ for H.

estimate for actual task.

## 1.21.1 Performance measures for $\hat{H}$:

TNR: True Negative Rate $P_{TN} = P(TN)$

$= \cancel{\dfrac{P(\hat{H} = H_0)}{P(\hat{H} = H_0)}} = P(\hat{H} = H_0 \mid H = H_0)$ cond prob

$\neq P(\hat{H} = H_0, H = H_0)$ joint prob.

FPR: False positive rate $P_{FP} = P(\hat{H} = H_1 \mid H = H_0)$

FNR: False negative rate $P_{FN} = P(\hat{H} = H_0 \mid H = H_1)$

TPR: True positive rate $P_{TP} = P(\hat{H} = H_1 \mid H = H_1)$