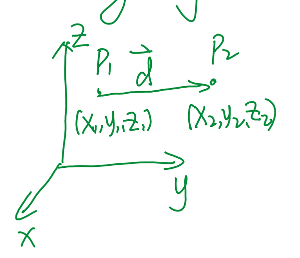
nobis Distance

Thursday, July 2, 2020 9:04 AM

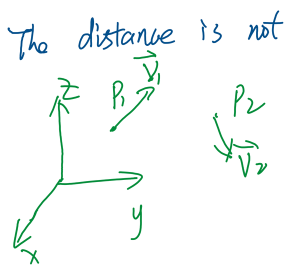
o Distance:

The length of the vector between two points



$$d = |\vec{d}| = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2}$$

The distance is not just for positions.

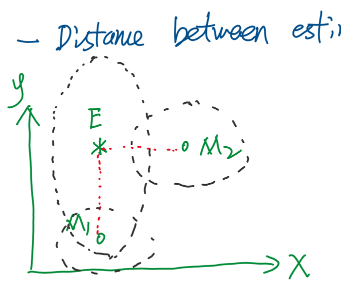


$$\vec{d}_v = \vec{V}_2 - \vec{V}_1$$

$$|\vec{d}_v| = d_v = (\vec{d}_v^T \vec{d}_v)^{1/2}$$

o Distance for estimation system.

– Distance between estimate and measurement.



$E \sim P$ → covariance

$M_1 \sim R_1$

$M_2 \sim R_2$

which measurement is closer to the estimate?

1) By crude observation : M_2 is closer.

2) Probabistic view : M_1 is closer.

o Mahalanobis Distance

– Definition:

Consider a point A with covariance C, and a point B, The the Mahalanobis distance is:

$$d^2 = (\vec{X}_B - \vec{X}_A)^T C^{-1} (\vec{X}_B - \vec{X}_A)$$

– Connection with Gaussian Distribution.

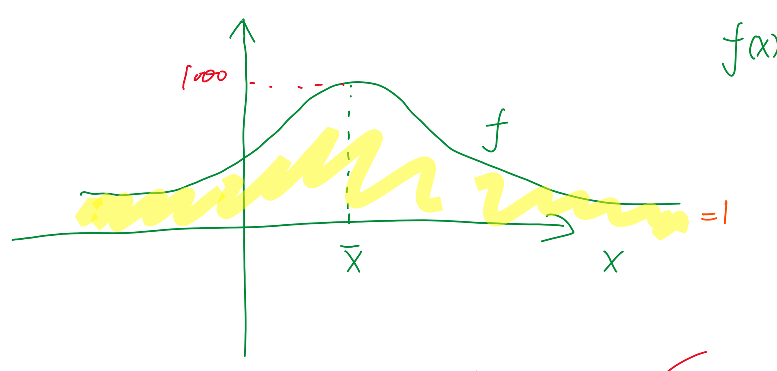
P.d.f. for multivariate Gaussian Distribution:

$$f = \frac{1}{\sqrt{\det(2\pi C)}} \exp\left(-\frac{1}{2} \underbrace{\vec{X}^T C^{-1} \vec{X}}_{d}\right)$$

↳ d : mahalanobis distance

tip: f is the probability density, not probability.

Normal distribution:



Probability <= 1

$f(x) \in R$

$$\int_{-\infty}^{+\infty} f(x)\, dx = 1$$

f(x) arbitrary large

o Matlab program for Mahalanobis distance. ✓