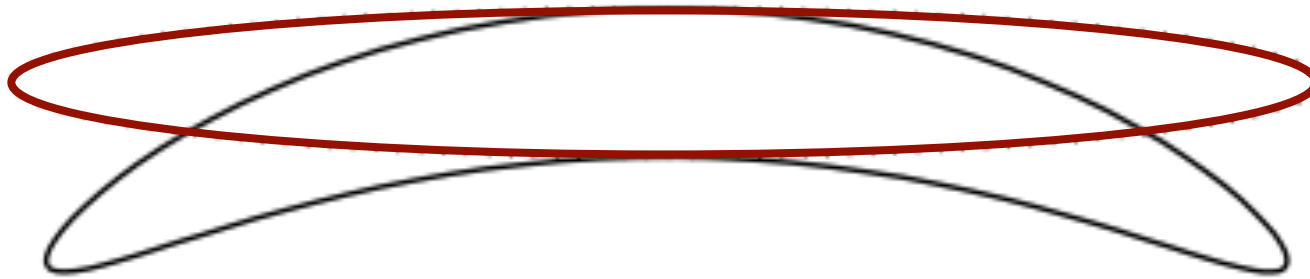
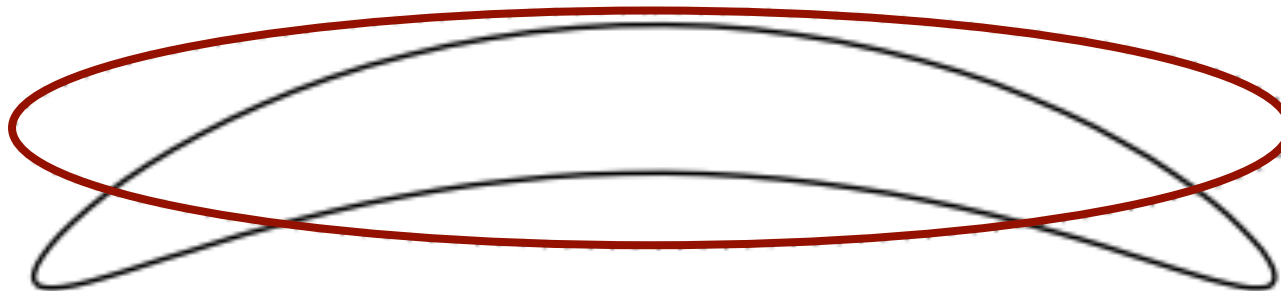


UKF vs. EKF – Banana Shape

EKF approximation

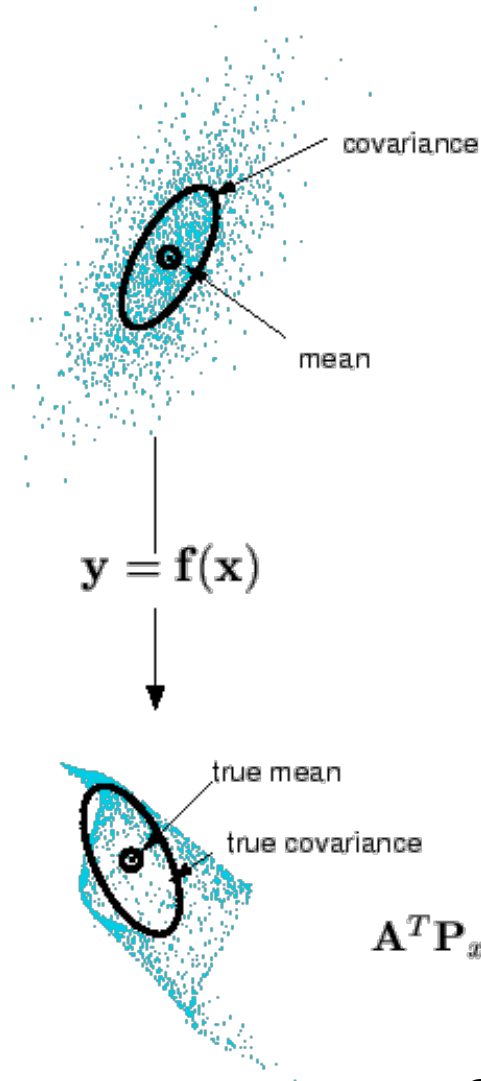


UKF approximation

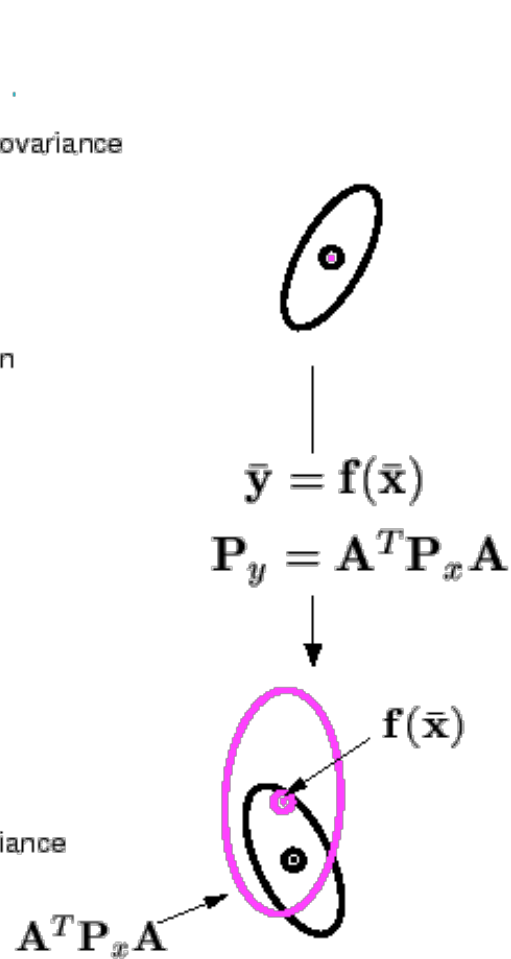


UKF vs. EKF

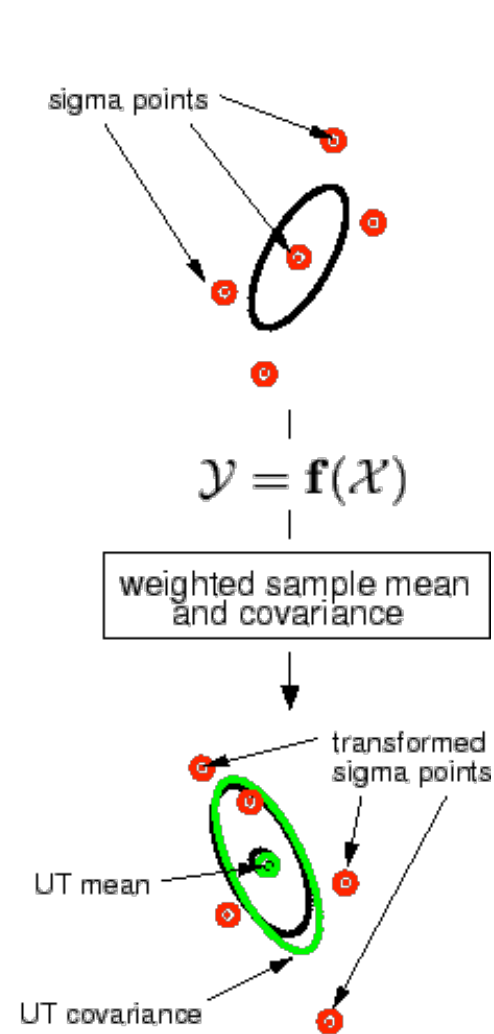
Actual (sampling)



Linearized (EKF)



UT



Courtesy: E.A. Wan and R. van der Merwe

3 examples of Error Propagation (Covariance propagation)

$$1. \quad y = Ax \quad , \quad A = \begin{bmatrix} 0.8 & 0.2 \\ 0.3 & 1.2 \end{bmatrix} , \quad X \sim \text{MVN} \left[\mu_x = \begin{bmatrix} 0 \\ 0 \end{bmatrix} , \Sigma_{xx} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \right]$$

lin 01. pdf

$$2. \quad y = \begin{bmatrix} \sqrt{x_1^2 + x_2^2} \\ \tan^{-1}(x_2/x_1) \end{bmatrix} , \quad J = \begin{bmatrix} \frac{x_1}{\sqrt{x_1^2 + x_2^2}} & \frac{x_2}{\sqrt{x_1^2 + x_2^2}} \\ \frac{-x_2}{x_1^2 + x_2^2} & \frac{x_1}{x_1^2 + x_2^2} \end{bmatrix}$$

$$X \sim \text{MVN} \left[\mu_x = \begin{bmatrix} 0.4 \\ 0.3 \end{bmatrix} , \Sigma_{xx} = \begin{bmatrix} (0.001)^2 & 0 \\ 0 & (0.001)^2 \end{bmatrix} \right]$$

nonlin 01. pdf

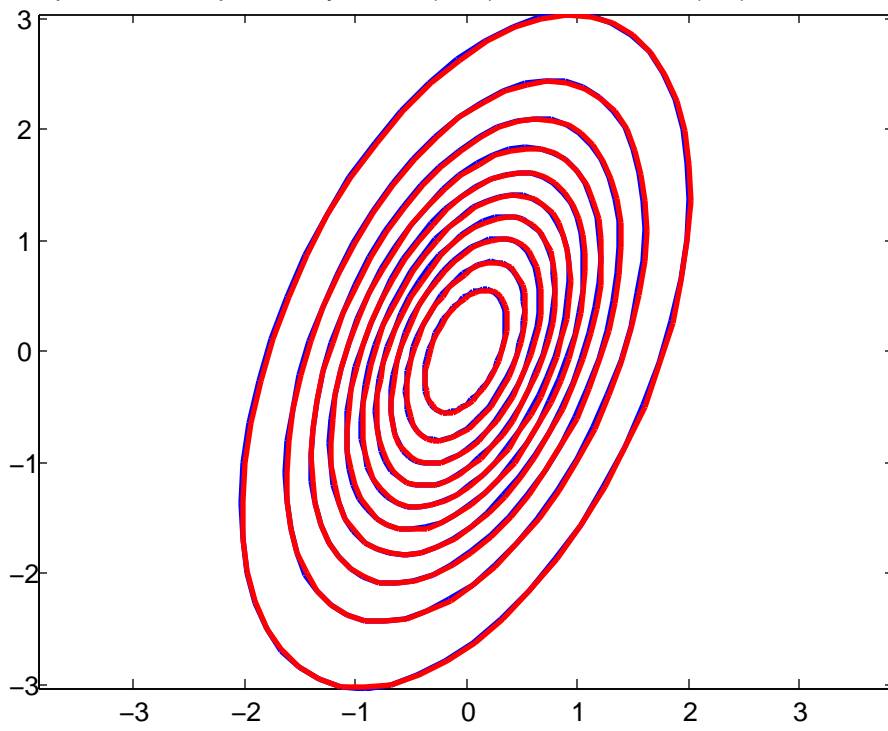
(choose length units = km.)

$$3. \quad y = \begin{bmatrix} x_1^2 x_2 \\ x_2^3 - x_1^2 \end{bmatrix} , \quad J = \begin{bmatrix} 2x_1 x_2 & x_1^2 \\ -2x_1 & 3x_2^2 \end{bmatrix}$$

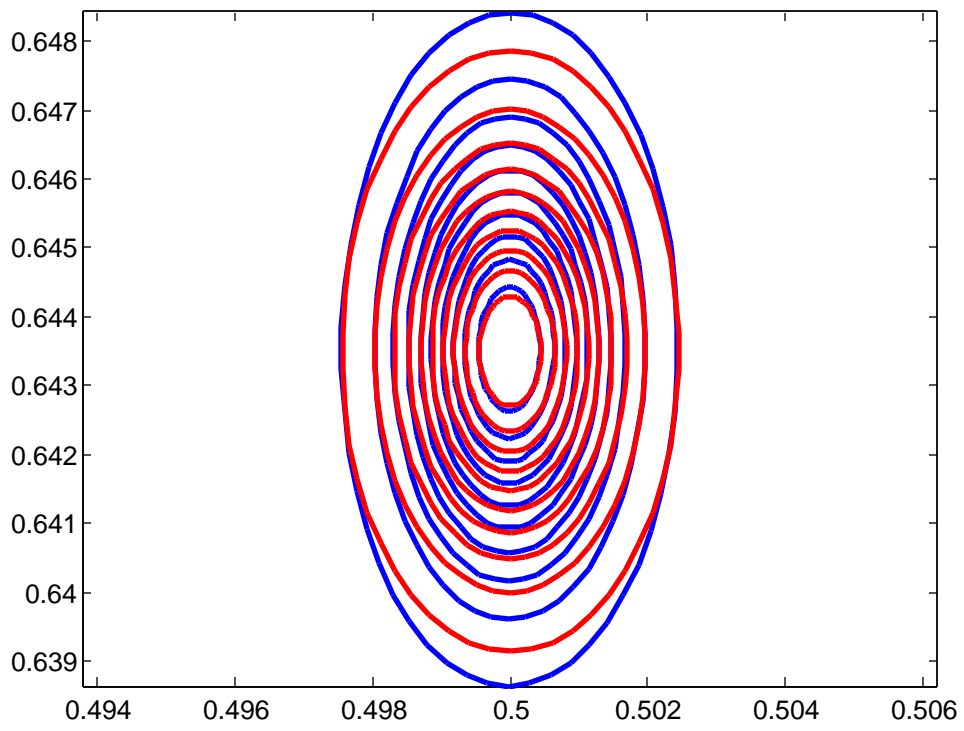
$$X \sim \text{MVN} \left[\mu_x = \begin{bmatrix} 1 \\ 2 \end{bmatrix} , \Sigma_{xx} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \right]$$

nonlin 02. pdf

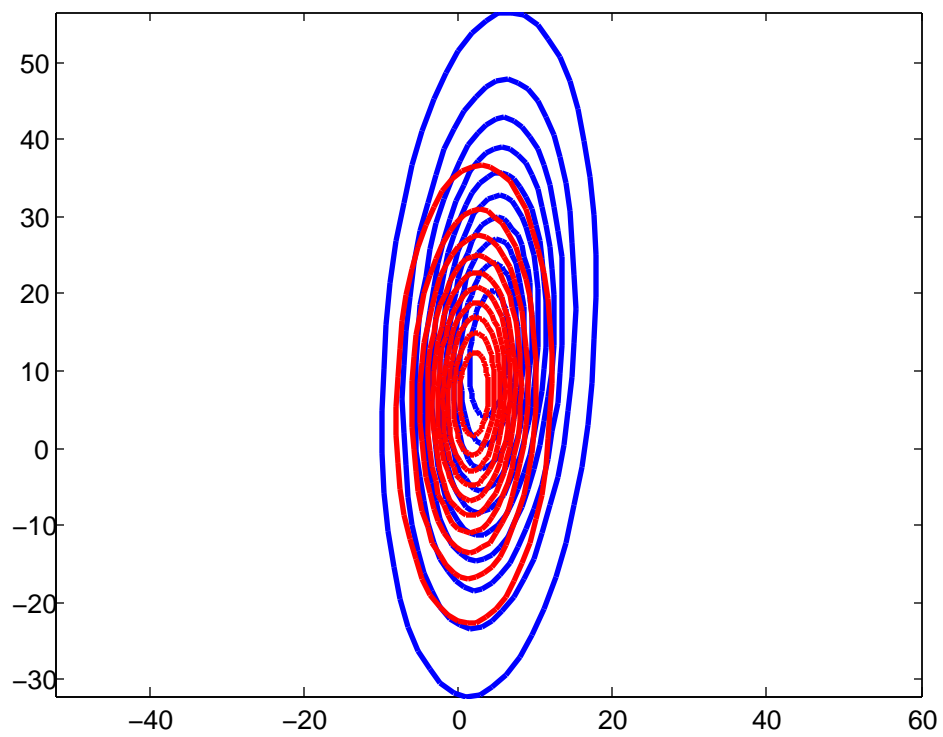
compare bivariate probability for EP (blue) vs. monte carlo (red), linear function

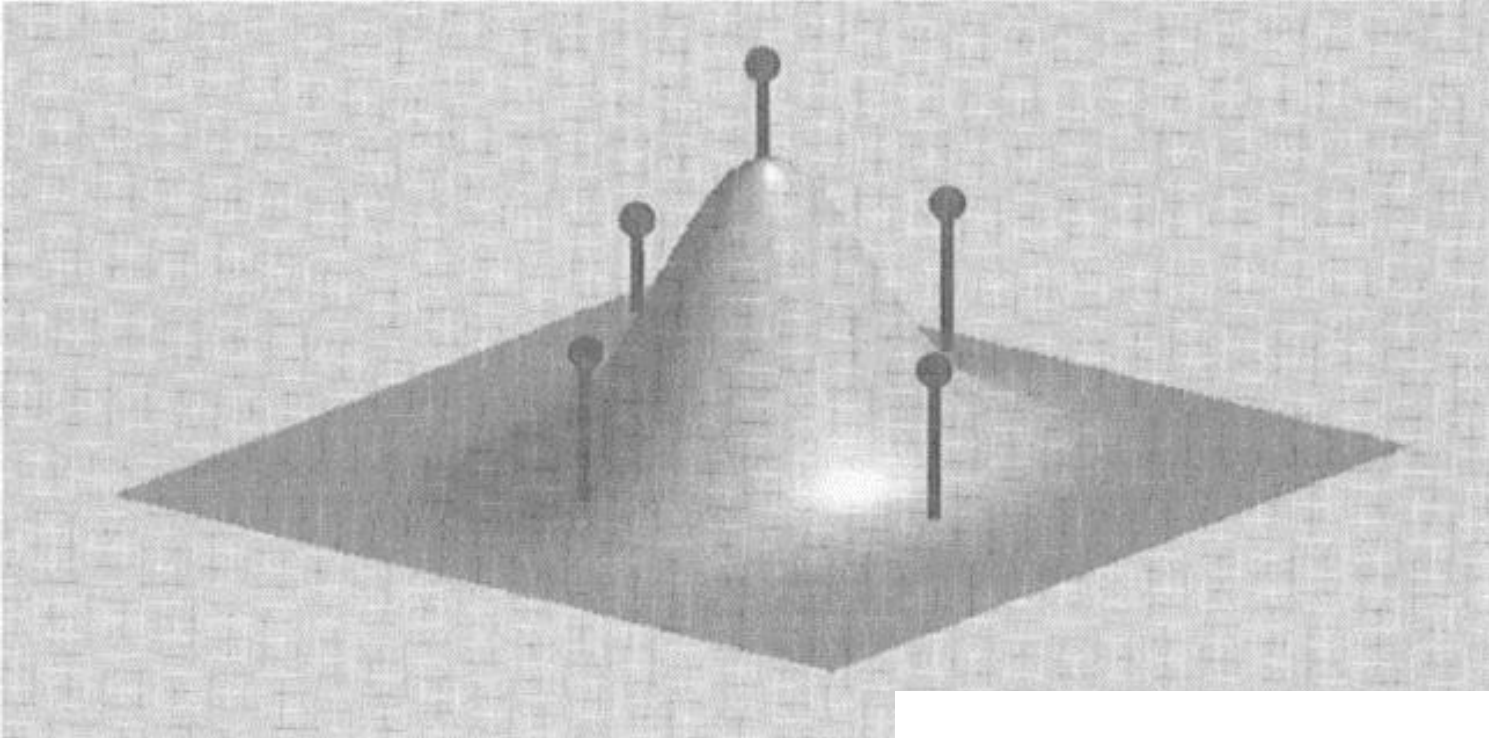


compare bivariate probability for EP (blue) vs. monte carlo (red), nonlinear function



compare bivariate probability for EP (blue) vs. monte carlo (red), nonlinear function





Taken from Phil Kim, K.F. for Beg.

