Automated code to determine TDOA from any satellite configuration

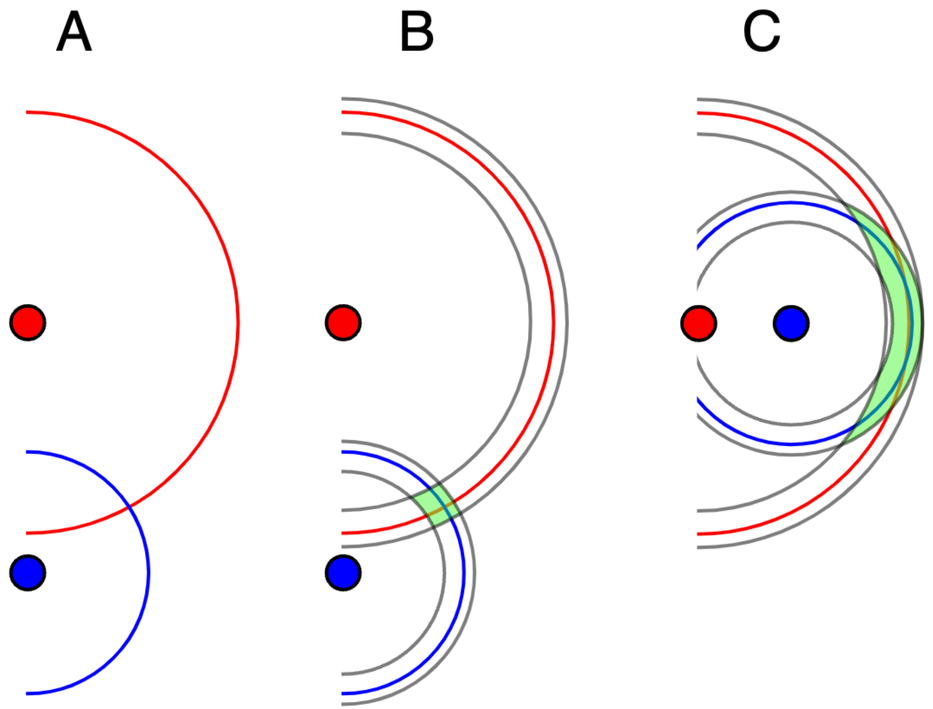
(1) Determining the Geometric Dilution of Precision (GDOP)

Dale Weigt - Solar Group Meeting 3/2/23

GDOP

- Measure of error propagation due to satellite geometry and how it affects measurement precision.

- $$\mathrm{GDOP} = \frac{\Delta(\text{output location})}{\Delta(\text{measured data})}$$



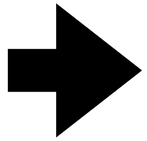
GDOP: computation

- Compute unit vectors from source to satellite.
- Formulate matrix, A.
- Formulate covariance matrix, Q.

where $Ri = \sqrt{(x_i - x)^2 + (y_i - y)^2 + (z_i - z)^2}$

$$A = \begin{bmatrix} \frac{x_1 - x}{R_1} & \frac{y_1 - y}{R_1} & \frac{z_1 - z}{R_1} & 1 \\ \frac{x_2 - x}{R_2} & \frac{y_2 - y}{R_2} & \frac{z_2 - z}{R_2} & 1 \\ \frac{x_3 - x}{R_3} & \frac{y_3 - y}{R_3} & \frac{z_3 - z}{R_3} & 1 \\ \frac{x_4 - x}{R_4} & \frac{y_4 - y}{R_4} & \frac{z_4 - z}{R_4} & 1 \end{bmatrix}$$

$$Q = (A^{\mathrm{T}}A)^{-1} = \begin{bmatrix} \sigma_x^2 & \sigma_{xy} & \sigma_{xz} & \sigma_{xt} \\ \sigma_{xy} & \sigma_y^2 & \sigma_{yz} & \sigma_{yt} \\ \sigma_{xz} & \sigma_{yz} & \sigma_z^2 & \sigma_{zt} \\ \sigma_{xt} & \sigma_{yt} & \sigma_{zt} & \sigma_t^2 \end{bmatrix}$$



$$\mathrm{GDOP} = \sqrt{\mathrm{tr}(Q)}$$

GDOP: computation