Geophysical Geodesy GEOL 700(i)

Day 4: September 8, 2011

• Discussion of Humphreys and Coblentz, 2007,
Led by Amy. Long paper, deserves much discussion.
Most of class time dedicated to this paper.

• Next: Read Flesch et al., 2000.
Older paper, shorter. Different methodology with simlar objectives. Uses deformation rather than stress measures as a constraint.

• See sheet on Problem Set #2 for details about lecture that occurred on this day.

• Problem Set #2 will be due Thursday.

Uncertainty and Covariance

σ_x is the uncertainty in the estimate of x "1-sigma".

σ_x^2 is the estimate of variance in the estimate of x

σ_{xy} is the covariance between x and y

$$cov(\boldsymbol{V}_{xyz}) = \begin{bmatrix} \sigma_x^2 & \sigma_{xy} & \sigma_{xz} \\ \sigma_{yx} & \sigma_y^2 & \sigma_{yz} \\ \sigma_{zx} & \sigma_{zy} & \sigma_z^2 \end{bmatrix}$$ is the covariance matrix.

$$corr(x, y) = \frac{\sigma_{xy}}{\sigma_x \sigma_y}$$ is the correlation between x and y (see GMT psvelo)

So when rotating from xyz to ned

$$\boldsymbol{V}_{ned} = \boldsymbol{T}\,\boldsymbol{V}_{xyz}$$

where $$T = \begin{bmatrix} Tnx & Tny & Tnz \\ Tex & Tey & Tez \\ Tdx & Tdy & Tdz \end{bmatrix}$$

$$cov(\boldsymbol{V}_{ned}) = \boldsymbol{T}\, cov(\boldsymbol{V}_{xyz})\, \boldsymbol{T}^{\boldsymbol{T}}$$

Even if $cov(\boldsymbol{V}_{xyz})$ is diagonal, $cov(\boldsymbol{V}_{ned})$ may not be (likely won't be), so we need to take covariance into account when wanting to know uncertainties in the rotated system.

Velocity uncertainty ellipses, 95% confidence region, etc.

Most of the time the uncertainty ellipses are close to circular when looking at just the horizontal. However XYZ almost always includes some of the vertical component as well, so its important to get the vertical uncertainty (which is much larger) out by keeping track of covariance.