Adjustment of Geospatial Observations
Fall 2019

Syllabus

* definitions: model, functional model, stochastic model, observation, redundancy, weight, condition equation, constraint equation, residual (correction), parameter, reference variance (variance of unit weight, sigma-nought-squared, proportionality factor), counting, n, n0, r, u, c
* objective function, LS, indirect observations, observations only, mixed model (general LS)
* indirect observations, scalar algebra approach
* linear examples: leveling, angle figures, length figures, regression
* constrained minimization, lagrange multipliers, observations only, scalar algebra approach
* solution of linear systems of equations, matrix rank, inverse, linear independence, dependence, condition number
* matrix derivation of LS, I/O, O/O
* matrix naming conventions
* more linear models: curve fit, surface fit, spline, ANOVA, coordinate transformations
* derive 2D rotation, 2D coordinate transformations, 2D conformal, 2D affine 3D conformal
* non-linear models, equations, newton method in 1D, 2D, nD, jacobian
* taylor series linearization, partial derivatives: analytical, numerical approximation, symbolic, iterations, convergence
* non-linear examples: 2D/3D ranging
* probability, random variables, PDF, CDF, ICDF, discrete, continuous
* probability distributions: normal, t, chi-square, F, MVN
* mean, variance, standard deviation, covariance, correlation coefficient, random vector
* covariance matrix, error propagation, 1-step, 2-step, ...
* error propagation for I/O, O/O, M/M
* confidence interval, confidence region, eigenvalues, eigenvectors
* hypothesis tests, test statistics, global test on ref. var. (chi-squared or F) critical values
* confidence ellipse, confidence ellipsoid, confidence circle, CE/LE, numerical integration
* plane surveying models: traverse, triangulation, trilateration, angle observations, direction observations
* eight parameter transformation (plane to plane via perspective center), pseudo LS, RPC: rational polynomial coefficients
* 3D rotations, rotation parameters, euler, sequential rotations, quaternions, algebraic, axis-angle, direction cosines
* mixed model = general LS, matrix derivation, error propagation
* mixed model: curve fit with all coordinates observed, model element counting, 3D coordinate transformation
* point cloud processing: 6,7 parameter transformation, estimation, merging
* GPS pseudo range observables, adjustment, RINEX, error propagation
* parameter constraints, direct, elimination, rank of system without constraints
* unified LS, prior uncertainties known, bayesian estimation
* sequential estimation
* kalman filter
* robust estimation, blunder detection & location, data snooping, IRLS, L1-minimization, redundancy numbers
* commercial adjustment software