TEL 603E – Convex Analysis for Signal Processing

Fall 2015

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References : S. Boyd, L. Vandenberghe, 'Convex Optimization', Cambridge University Press, 2004.
J.-P. Hiriart-Urruty, C. Lemaréchal, 'Fundamentals of Convex Analysis', Springer, 2001.
R. T. Rockafellar, 'Convex Analysis', Princeton University Press, 1996.
R. T. Rockafellar, 'Conjugate Duality and Optimization', SIAM, 1987.
C. L. Byrne, 'Iterative Optimization in Inverse Problems', Chapman and Hall/CRC, 2014.

Grading : Homeworks (20%), 1 Midterm (30%), Final (50%).

Tentative Course Outline

- Review of Linear Algebra

  Vector spaces, subspaces, basis, dimension, orthogonality, eigen analysis.

- Convex Sets

  Operations that preserve convexity of sets, convex/affine hulls, projections, separation, tangent and normal cones.

- Convex Functions

  Epigraph, Jensen's inequality, operations preserving convexity of functions, first and second order differentiation, conjugate functions.

- Duality

  Saddle point duality, Lagrange multipliers, the dual problem, Slater's condition.

- Subdifferentials

  Different geometrical interpretations, calculus rules on subdifferentials, monotone operators

- Applications and Some Iterative Algorithms

  The augmented Lagrangian, ADMM, variational problems, POCS, Dykstra's algorithm, forward-backward algorithm, Douglas-Rachford algorithm, majorization-minimization, support vector machines...