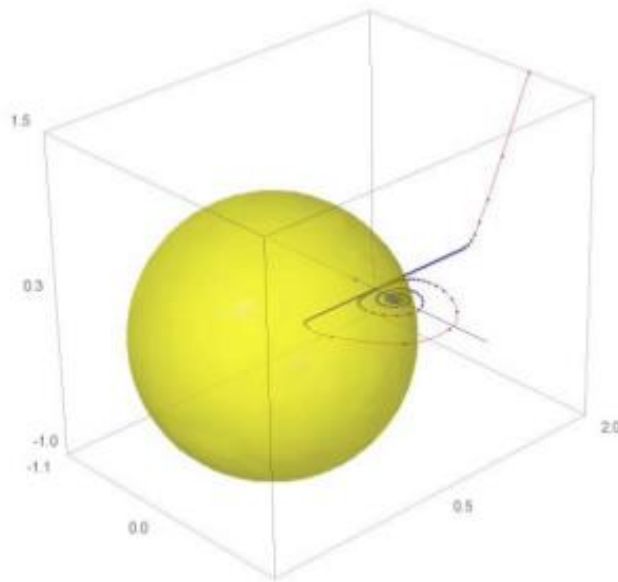


Theory and Applications of Convex and Non-Convex Feasibility Problems



Main Lecturer: Jonathan M Borwein*, CARMA**, University of Newcastle, Australia

Other Lecturers: G. Reid (U of Western Ontario) and H. Wolkowicz (U Waterloo).

Abstract: A *feasibility problem* is: Given finitely many closed sets lying in a Hilbert space, find a point lying in the intersection of these sets. We consider *iterative methods* based on the non-expansive properties of the *metric projection* $P_C(x) = \operatorname{argmin}_{c \in C} \|x - c\|$ or *reflection operator* $R_C := 2P_C - I$ on a closed convex set C in Hilbert space. These methods work best when the projection on each set in the intersection is easy to describe or approximate. They are especially useful when the number of sets involved is large as the methods are fairly easy to parallelize. The theory is pretty well understood when all sets are convex, but much less clear in the non-convex case. But application of this case has had many successes. Jonathan Borwein will cover this material in Lectures 1 – 5 below. Lecture 6 (Wolkowicz) explores the fundamental role of facial reduction and Lecture 7 (Reid) new results in numerical real algebraic geometry.

1. *Alternating projection methods: background theory, convergence & algorithms.* Borwein: April 29, 11 am – 12 [Slides]
2. *The Douglas Rachford reflection method and generalizations.* Borwein: April 29, 2 pm – 3 [Slides]
3. *Applications to convex problems, non-convex problems and to matrix completion problems.* Borwein: May 3, 11 am – 12 [Slides]
4. *Protein conformation determination: a detailed case study.* Borwein: May 3, 2 pm – 3 [Slides]
5. *Relaxed reflection methods and norm convergence for realistic problems.* Borwein: May 5: 11 am – 12 [Slides]
6. *Three views of facial reduction in cone optimization.* Wolkowicz, May 5: 2 pm – 3. [Related Slides]
7. *Convex optimization and SDP in numerical real algebraic geometry.* Reid, May 9: 11 am – 12 [arXivRef]

Venue: Lecture 1: Middlesex College Room 105B. Lectures 2 – 7: Western Science Centre Room 240.

Coordinator: Greg Reid reid@uwo.ca. Note this can also be taken as part of a ¼ credit graduate course. Please contact Greg.

Jonathan M. Borwein* (FRSC, FAAAS, FBAS, FAustMS, FAA, FAMS, FRSNSW) and **CARMA**** (Priority Research Centre for Computer Assisted Research Mathematics and its Applications).

Related Web Links: [Slides – Borwein’s Lectures]: <https://carma.newcastle.edu.au/DRmethods/paseky.html>

Related Conference: *Computationally assisted mathematical discovery and experimental mathematics:* <https://acmes.org/>