Invited Talk Abstract

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Pushing the Complexity Boundaries of Fixed-Point Equations: Adaptive Algorithm at the Tractability Frontier

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Date	July 28, 2026
Time	10:00–10:30
Session	Session 4
Venue	S102, Lecture Hall, Gong-Guan Campus, NTNU

Abstract

High-dimensional settings of fixed-point operator equations $T(x) = x$ arise across optimization, game theory, economics, and machine learning. When the operator T is contractive or nonexpansive, efficient algorithms with tight complexity guarantees are well established. For even mildly expansive operators, however, worst-case exponential lower bounds arise. This raises a natural question: where exactly does the tractability frontier lie? In this talk, I will present recent results that identify new tractable regimes beyond nonexpansiveness. I will introduce the Adaptive Gradual Halpern Algorithm (AdaGHAL), a fully parameter-free method that recovers optimal oracle complexities for contractive and nonexpansive operators while extending guarantees to mildly expansive operators up to the known hardness boundary. I will then introduce the class of gradually expansive operators—permitting Lipschitz constants up to approximately $\sqrt{2}$—and show that AdaGHAL finds ε-approximate fixed points in $O(1/\varepsilon)$ iterations in this regime. These results hold in general normed spaces, including infinite-dimensional Banach spaces. I will conclude with implications for root-finding problems and weakly convex optimization, along with open questions.