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Level proximal subdifferential, variational convexity, and beyond.

Discovered by Rockafellar in 2021, level proximal subdifferential has the pleasant feature that every proximal operator is the resolvent of a level proximal subdifferential operator. In this talk, we present a systematic study of the level proximal subdifferential, revealing its remarkable connections to the classic Fenchel subdifferential in convex analysis and to proximal hulls of proper, lsc, and prox-bounded functions. An interpretation of our results in view of the Φ-subdifferential in optimal transport will be discussed. Furthermore, we established a full equivalence between variational convex functions, local (firmly) nonexpansive proximal operators, and relative (maximal) monotone level proximal subdifferential operators, which unifies and extends recent advances by Rockafellar in 2021 and by Khanh, Mordukhovich, and Phat in 2023. A pointwise version of Lipschitz smoothness will be investigated through the lens of the level proximal subdifferential. The talk is based on joint works with Honglin Luo, Xianfu Wang, and Xinmin Yang, and with Andreas Themelis and Xianfu Wang.