

## SECOND-ORDER VARIATIONAL ANALYSIS IN SECOND-ORDER CONE PROGRAMMING

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**Abstract.** In this talk, we first discuss the notion of second epi-derivatives of an extended-real valued function, one of our main devices in conducting a second-order variational analysis for an important class of nonpolyhedral conic programs generated by the so-called second-order/Lorentz/ice-cream cone  $\mathcal{Q}$ . We then prove that the indicator function of  $\mathcal{Q}$  is always twice epi-differentiable and apply this result to characterizing the uniqueness of Lagrange multipliers together with an error bound estimate in the general second-order cone programming setting involving twice differentiable data. The obtained precise formula for second epi-derivative for  $\delta_{\mathcal{Q}}$  allows us to get that for augmented Lagrangians associated with second-order cone programming problems. a complete characterization for quadratic growth condition for the augmented problems is derived as an application of our results.

**Keywords** Second-order conic programs, Nonpolyhedral systems, Error bounds, Second-order variational analysis, Twice epi-differentiability, Augmented Lagrangians

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