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Canonical Duality Theory and its Role in Global Optimization

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Canonical duality theory is a newly developed, potentially powerful methodology, which is composed mainly of a canonical dual transformation and a triality theory. The canonical dual transformation can be used to formulate perfect dual problems without duality gap, while the triality theory reveals an interesting duality pattern in general nonconvex system and plays a fundamental role in nonconvex analysis and global optimization.

In this talk, the speaker will present a comprehensive review and some new developments on the canonical duality theory and its applications in global optimization. By using the most simple but fundamentally difficult (NP-hard) quadratic programming problem, the speaker will reveal a unified structure and a splendid beauty in mathematical programming. He will show that by using the canonical dual transformation, many well-known nonconvex/nonsmooth problems in high dimensional space can be reformulated into certain smooth canonical dual problems in lower dimensional space; integer programming problems can be converted to certain continuous dual problems; a large class of constrained nonlinear optimization problems can be assembled in a unified framework. An insightful relation between the canonical dual transformation and nonlinear (or extended) Lagrange multiplier methods is presented. The triality theory can be used to identify both global and local optimizers and to develop some potentially powerful algorithms for solving many challenging problems.

Extensive applications will be illustrated by general nonconvex constrained problems in global optimization. Complete solutions to certain well-known difficult problems will be presented, including polynomial minimization, nonconvex programming with box, integer, and multi-quadratic constraints. This talk should bring some fundamentally new insights into global optimization and computational science.