Ivan Singer

Duality for Nonconvex Approximation and Optimization

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Duality For Nonconvex Approximation And Optimization Cmss In Mathematics

C.j. Goh

Duality For Nonconvex Approximation And Optimization Cmss In Mathematics:

Duality for Nonconvex Approximation and Optimization Ivan Singer,2006-01-01 The theory of convex optimization has been developing constantly over the past 30 years Recently researchers have been studying more complicated classes of problems that still can be studied by means of convex analysis so called anticonvex and convex anticonvex optimization problems This monograph contains an exhaustive presentation of the duality theory for these classes of problems and their generalizations *Duality Principles in Nonconvex Systems* David Yang Gao,2013-03-09 Motivated by practical problems in engineering and physics drawing on a wide range of applied mathematical disciplines this book is the first to provide within a unified framework a self contained comprehensive mathematical theory of duality for general non convex non smooth systems with emphasis on methods and applications in engineering mechanics Topics covered include the classical minimax mono duality of convex static equilibria the beautiful bi duality in dynamical systems the interesting tri duality in non convex problems and the complicated multi duality in general canonical systems A potentially powerful sequential canonical dual transformation method for solving fully nonlinear problems is developed heuristically and illustrated by use of many interesting examples as well as extensive applications in a wide variety of nonlinear systems including differential equations variational problems and inequalities constrained global optimization multi well phase transitions non smooth post bifurcation large deformation mechanics structural limit analysis differential geometry and non convex dynamical systems With exceptionally coherent and lucid exposition the work fills a big gap between the mathematical and engineering sciences It shows how to use formal language and duality methods to model natural phenomena to construct intrinsic frameworks in different fields and to provide ideas concepts and powerful methods for solving non convex non smooth problems arising naturally in engineering and science Much of the book contains material that is new both in its manner of presentation and in its research development A self contained appendix provides some necessary background from elementary functional analysis Audience The book will be a valuable resource for students and researchers in applied mathematics physics mechanics and engineering The whole volume or selected chapters can alsobe recommended as a text for both senior undergraduate and graduate courses in applied mathematics mechanics general engineering science and other areas in which the notions of optimization and variational methods are employed Canonical Duality Theory David Yang Gao,Vittorio Latorre,Ning Ruan,2017-10-09 This book on canonical duality theory provides a comprehensive review of its philosophical origin physics foundation and mathematical statements in both finite and infinite dimensional spaces A ground breaking methodological theory canonical duality theory can be used for modeling complex systems within a unified framework and for solving a large class of challenging problems in multidisciplinary fields in engineering mathematics and the sciences This volume places a particular emphasis on canonical duality theory s role in bridging the gap between non convex analysis mechanics and global optimization With 18 total chapters written by experts in their fields this volume

provides a nonconventional theory for unified understanding of the fundamental difficulties in large deformation mechanics bifurcation chaos in nonlinear science and the NP hard problems in global optimization Additionally readers will find a unified methodology and powerful algorithms for solving challenging problems in complex systems with real world applications in non convex analysis non monotone variational inequalities integer programming topology optimization post buckling of large deformed structures etc Researchers and graduate students will find explanation and potential applications in multidisciplinary fields **Duality in Optimization and Variational Inequalities** C.j. Goh,2002-05-10 This comprehensive volume covers a wide range of duality topics ranging from simple ideas in network flows to complex issues in non convex optimization and multicriteria problems In addition it examines duality in the context of variational inequalities and vector variational inequalities as generalizations to optimization Duality in Optimizati *Duality in Nonconvex Optimization and Calculus of Variations* Ivar Ekeland,WISCONSIN UNIV MADISON MATHEMATICS RESEARCH CENTER.,1976 A general duality theory is given for smooth nonconvex optimization problems covering both the finite dimensional case and the calculus of variations The results are quite similar to the convex case in particular with every problem P is associated a dual problem P having opposite value Conjugate Duality and Optimization R. Tyrrell Rockafellar,1974-01-01 The theory of duality in problems of optimization is developed in a setting of finite and infinite dimensional spaces using convex analysis Applications to convex and nonconvex problems Expository account containing many new results Author **Approximation and Optimization of Discrete and Differential Inclusions** Elimhan N Mahmudov,2011-08-25 Optimal control theory has numerous applications in both science and engineering This book presents basic concepts and principles of mathematical programming in terms of set valued analysis and develops a comprehensive optimality theory of problems described by ordinary and partial differential inclusions In addition to including well recognized results of variational analysis and optimization the book includes a number of new and important ones Includes practical examples *Conjugate Duality in Convex Optimization* Radu Ioan-Bot,2011-03-03 The results presented in this book originate from the last decade research work of the author in the eld of duality theory in convex optimization The reputation of duality in the optimization theory comes mainly from the major role that it plays in formulating necessary and suf cient optimality conditions and consequently in generatingdifferent algorithmic approachesfor solving mathematical programming problems The investigations made in this work prove the importance of the duality theory beyond these aspects and emphasize its strong connections with different topics in convex analysis nonlinear analysis functional analysis and in the theory of monotone operators The rst part of the book brings to the attention of the reader the perturbation approach as a fundamental tool for developing the so called conjugate duality t ory The classical Lagrange and Fenchel duality approaches are particular instances of this general concept More than that the generalized interior point regularity conditions stated in the past for the two mentioned situations turn out to be p ticularizations of the ones given in this general setting In our

investigations the perturbation approach represents the starting point for deriving new duality concepts for several classes of convex optimization problems Moreover via this approach generalized Moreau Rockafellar formulae are provided and in connection with them a new class of regularity conditions called closedness type conditions for both stable strong duality and strong duality is introduced By stable strong duality we understand the situation in which strong duality still holds whenever perturbing the objective function of the primal problem with a linear continuous functional **Canonical Duality Theory for Global Optimization Problems and Applications** Yi Chen,2015 The canonical duality theory is studied through a discussion on a general global optimization problem and applications on fundamentally important problems This general problem is a formulation of the minimization problem with inequality constraints where the objective function and constraints are any convex or nonconvex functions satisfying certain decomposition conditions It covers convex problems mixed integer programming problems and many other nonlinear programming problems The three main parts of the canonical duality theory are canonical dual transformation complementary dual principle and triality theory The complementary dual principle is further developed which conventionally states that each critical point of the canonical dual problem is corresponding to a KKT point of the primal problem with their sharing the same function value The new result emphasizes that there exists a one to one correspondence between KKT points of the dual problem and of the primal problem and each pair of the corresponding KKT points share the same function value which implies that there is truly no duality gap between the canonical dual problem and the primal problem The triality theory reveals insightful information about global and local solutions It is shown that as long as the global optimality condition holds true the primal problem is equivalent to a convex problem in the dual space which can be solved efficiently by existing convex methods even if the condition does not hold the convex problem still provides a lower bound that is at least as good as that by the Lagrangian relaxation method It is also shown that through examining the canonical dual problem the hidden convexity of the primal problem is easily observable The canonical duality theory is then applied to dealing with three fundamentally important problems The first one is the spherically constrained quadratic problem also referred to as the trust region subproblem The canonical dual problem is onedimensional and it is proved that the primal problem no matter with convex or nonconvex objective function is equivalent to a convex problem in the dual space Moreover conditions are found which comprise the boundary that separates instances into 2hard case3 and 2easy case3 A canonical primal dual algorithm is developed which is able to efficiently solve the problem including the 2hard case3 and can be used as a unified method for similar problems The second one is the binary quadratic problem a fundamental problem in discrete optimization The discussion is focused on lower bounds and analytically solvable cases which are obtained by analyzing the canonical dual problem with perturbation techniques The third one i is a general nonconvex problem with log sum exp functions and quartic polynomials It arises widely in engineering science and it can be used to approximate nonsmooth optimization problems The work shows that problems can still be

efficiently solved via the canonical duality approach even if they are nonconvex and nonsmooth Abstract *Duality in Vector Optimization* Radu Ioan Bot,Sorin-Mihai Grad,Gert Wanka,2009-08-12 This book presents fundamentals and comprehensive results regarding duality for scalar vector and set valued optimization problems in a general setting One chapter is exclusively consecrated to the scalar and vector Wolfe and Mond Weir duality schemes **An Extension of Duality-stability Relations to Nonconvex Optimization Problems** Erik Jan Balder,1976 Conjugate Duality and Optimization Ralph Tyrrell Rockafellar,1989 Duality and Approximation for Special Classes of Optimization Problems Horaţiu Vasile Boncea,2012 **Duality and Approximation Methods for Cooperative Optimization and Control** Mathias Bürger,2014 **Strong Duality in Nonconvex Quadratic Optimization with Two Quadratic Constraints** Amir Beck,Yonina C. Eldar,Ṭekhniyon, Makhon ṭekhnologi le-Yiśra'el. Fakultah le-handasat hashmal. Merkaz le-tekhnologyot tikshoret u-meda,2005 **Primal-dual Symmetry and Scale Invariance of Interior-point Algorithms for Convex Optimization** Tunçel, Levent,University of Waterloo. Department of Combinatorics and Optimization,University of Waterloo. Faculty of Mathematics,1996 **Theory of Duality in Mathematical Programming** Manfred Walk,1989 **Duality and Sensitivity in Nonconvex Quadratic Optimization Over a Sphere** Olaf Erik Flippo,Benjamin Jansen,Rijksuniversiteit te Limburg. Faculty of Economics,1993 The Numerical Method of Lines and Duality Principles Applied to Models in Physics and Engineering Fabio Silva Botelho,2024-02-06 The book includes theoretical and applied results of a generalization of the numerical method of lines A Ginzburg Landau type equation comprises the initial application with detailed explanations about the establishment of the general line expressions Approximate numerical procedures have been developed for a variety of equation types including the related algorithms and software The applications include the Ginzburg Landau system in superconductivity applications to the Navier Stokes system in fluid mechanics and among others models in flight mechanics In its second and final parts the book develops duality principles and numerical results for other similar and related models The book is meant for applied mathematicians physicists and engineers interested in numerical methods and concerning duality theory It is expected the text will serve as a valuable auxiliary project tool for some important engineering and physics fields of research **Strong Duality for Semidefinite Programming** Tunçel, Levent,Ramana, Motakuri,University of Waterloo. Department of Combinatorics and Optimization,Henry Wolkowicz,University of Waterloo. Faculty of Mathematics,1995

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