Topics in Optimal Transportation

Cédric Villani

Optimal Transportation Theory And Applications Cedric Villani

Hervé Pajot,Cédric Villani,Yann Ollivier

Optimal Transportation Theory And Applications Cedric Villani:

    Topics in Optimal Transportation Cédric Villani,2021-08-25 This is the first comprehensive introduction to the theory of mass transportation with its many and sometimes unexpected applications In a novel approach to the subject the book both surveys the topic and includes a chapter of problems making it a particularly useful graduate textbook In 1781 Gaspard Monge defined the problem of optimal transportation or the transferring of mass with the least possible amount of work with applications to engineering in mind In 1942 Leonid Kantorovich applied the newborn machinery of linear programming to Monge s problem with applications to economics in mind In 1987 Yann Brenier used optimal transportation to prove a new projection theorem on the set of measure preserving maps with applications to fluid mechanics in mind Each of these contributions marked the beginning of a whole mathematical theory with many unexpected ramifications Nowadays the Monge Kantorovich problem is used and studied by researchers from extremely diverse horizons including probability theory functional analysis isoperimetry partial differential equations and even meteorology Originating from a graduate course the present volume is intended for graduate students and researchers covering both theory and applications Readers are only assumed to be familiar with the basics of measure theory and functional analysis   **Optimal Transport** Yann Ollivier,Hervé Pajot,Cedric Villani,2014-08-07 The theory of optimal transportation has its origins in the eighteenth century when the problem of transporting resources at a minimal cost was first formalised Through subsequent developments particularly in recent decades it has become a powerful modern theory This book contains the proceedings of the summer school Optimal Transportation Theory and Applications held at the Fourier Institute in Grenoble The event brought together mathematicians from pure and applied mathematics astrophysics economics and computer science Part I of this book is devoted to introductory lecture notes accessible to graduate students while Part II contains research papers Together they represent a valuable resource on both fundamental and advanced aspects of optimal transportation its applications and its interactions with analysis geometry PDE and probability urban planning and economics Topics covered include Ricci flow the Euler equations functional inequalities curvature dimension conditions and traffic congestion   Optimal Transport Cédric Villani,2014-09-02 Lecture notes and research papers on optimal transportation its applications and interactions with other areas of mathematics   Optimal Transportation Hervé Pajot,Cédric Villani,Yann Ollivier,2014 Lecture notes and research papers on optimal transportation its applications and interactions with other areas of mathematics   **Optimal Transportation** Hervé Pajot,Cédric Villani,Yann Ollivier,2014 Lecture notes and research papers on optimal transportation its applications and interactions with other areas of mathematics   *Optimal Transport* Cédric Villani,2013-01-02 At the close of the 1980s the independent contributions of Yann Brenier Mike Cullen and John Mather launched a revolution in the venerable field of optimal transport founded by G Monge in the 18th century which has made breathtaking forays into various other domains of mathematics ever since The author presents a broad overview of this area supplying complete and

self contained proofs of all the fundamental results of the theory of optimal transport at the appropriate level of generality Thus the book encompasses the broad spectrum ranging from basic theory to the most recent research results PhD students or researchers can read the entire book without any prior knowledge of the field A comprehensive bibliography with notes that extensively discuss the existing literature underlines the book s value as a most welcome reference text on this subject

Optimal Transportation and Applications Luigi Ambrosio,Luis A. Caffarelli,Yann Brenier,Giuseppe Buttazzo,Cédric Villani,2003-01-01 Leading researchers in the field of Optimal Transportation with different views and perspectives contribute to this Summer School volume Monge Amp re and Monge Kantorovich theory shape optimization and mass transportation are linked among others to applications in fluid mechanics granular material physics and statistical mechanics emphasizing the attractiveness of the subject from both a theoretical and applied point of view The volume is designed to become a guide to researchers willing to enter into this challenging and useful theory *Optimal Transportation* Yann Ollivier,Hervé Pajot,Cédric Villani,2014-08-07 Lecture notes and research papers on optimal transportation its applications and interactions with other areas of mathematics *Optimal Transport Methods in Economics* Alfred Galichon,2018-08-14 Optimal Transport Methods in Economics is the first textbook on the subject written especially for students and researchers in economics Optimal transport theory is used widely to solve problems in mathematics and some areas of the sciences but it can also be used to understand a range of problems in applied economics such as the matching between job seekers and jobs the determinants of real estate prices and the formation of matrimonial unions This is the first text to develop clear applications of optimal transport to economic modeling statistics and econometrics It covers the basic results of the theory as well as their relations to linear programming network flow problems convex analysis and computational geometry Emphasizing computational methods it also includes programming examples that provide details on implementation Applications include discrete choice models models of differential demand and quantile based statistical estimation methods as well as asset pricing models Authoritative and accessible Optimal Transport Methods in Economics also features numerous exercises throughout that help you develop your mathematical agility deepen your computational skills and strengthen your economic intuition The first introduction to the subject written especially for economists Includes programming examples Features numerous exercises throughout Ideal for students and researchers alike *Optimal Transportation and Applications* Luigi Ambrosio,2003-06-12 Leading researchers in the field of Optimal Transportation with different views and perspectives contribute to this Summer School volume Monge Amp re and Monge Kantorovich theory shape optimization and mass transportation are linked among others to applications in fluid mechanics granular material physics and statistical mechanics emphasizing the attractiveness of the subject from both a theoretical and applied point of view The volume is designed to become a guide to researchers willing to enter into this challenging and useful theory

Topological Optimization and Optimal Transport Maïtine Bergounioux,Édouard Oudet,Martin Rumpf,Guillaume

Carlier,Thierry Champion,Filippo Santambrogio,2017-08-07 By discussing topics such as shape representations relaxation theory and optimal transport trends and synergies of mathematical tools required for optimization of geometry and topology of shapes are explored Furthermore applications in science and engineering including economics social sciences biology physics and image processing are covered Contents Part I Geometric issues in PDE problems related to the infinity Laplace operator Solution of free boundary problems in the presence of geometric uncertainties Distributed and boundary control problems for the semidiscrete Cahn Hilliard Navier Stokes system with nonsmooth Ginzburg Landau energies High order topological expansions for Helmholtz problems in 2D On a new phase field model for the approximation of interfacial energies of multiphase systems Optimization of eigenvalues and eigenmodes by using the adjoint method Discrete varifolds and surface approximation Part II Weak Monge Ampere solutions of the semi discrete optimal transportation problem Optimal transportation theory with repulsive costs Wardrop equilibria long term variant degenerate anisotropic PDEs and numerical approximations On the Lagrangian branched transport model and the equivalence with its Eulerian formulation On some nonlinear evolution systems which are perturbations of Wasserstein gradient flows Pressureless Euler equations with maximal density constraint a time splitting scheme Convergence of a fully discrete variational scheme for a thin film equatio Interpretation of finite volume discretization schemes for the Fokker Planck equation as gradient flows for the discrete Wasserstein distance **XVIth International Congress on Mathematical Physics** Pavel Exner,2010 The International Congress on Mathematical Physics is the flagship conference in this exciting field Convening every three years it gives a survey on the progress achieved in all branches of mathematical physics It also provides a superb platform to discuss challenges and new ideas The present volume collects material from the XVIth ICMP which was held in Prague August 2009 and features most of the plenary lectures and invited lectures in topical sessions as well as information on other parts of the congress program This volume provides a broad coverage of the field of mathematical physics from dominantly mathematical subjects to particle physics condensed matter and application of mathematical physics methods in various areas such as astrophysics and ecology amongst others *Nonlinear PDE's and Applications* Stefano Bianchini,Eric A. Carlen,Alexander Mielke,Cédric Villani,2011-07-30 This volume collects the notes of the CIME course Nonlinear PDE s and applications held in Cetraro Italy on June 23 28 2008 It consists of four series of lectures delivered by Stefano Bianchini SISSA Trieste Eric A Carlen Rutgers University Alexander Mielke WIAS Berlin and C dric Villani Ecole Normale Superieure de Lyon They presented a broad overview of far reaching findings and exciting new developments concerning in particular optimal transport theory nonlinear evolution equations functional inequalities and differential geometry A sampling of the main topics considered here includes optimal transport Hamilton Jacobi equations Riemannian geometry and their links with sharp geometric functional inequalities variational methods for studying nonlinear evolution equations and their scaling properties and the metric energetic theory of gradient flows and of rate independent evolution problems The book explores the

fundamental connections between all of these topics and points to new research directions in contributions by leading experts in these fields   **Diffusion, Quantum Theory, and Radically Elementary Mathematics** William G. Faris,2014-09-08 Diffusive motion displacement due to the cumulative effect of irregular fluctuations has been a fundamental concept in mathematics and physics since Einstein s work on Brownian motion It is also relevant to understanding various aspects of quantum theory This book explains diffusive motion and its relation to both nonrelativistic quantum theory and quantum field theory It shows how diffusive motion concepts lead to a radical reexamination of the structure of mathematical analysis The book s inspiration is Princeton University mathematics professor Edward Nelson s influential work in probability functional analysis nonstandard analysis stochastic mechanics and logic The book can be used as a tutorial or reference or read for pleasure by anyone interested in the role of mathematics in science Because of the application of diffusive motion to quantum theory it will interest physicists as well as mathematicians The introductory chapter describes the interrelationships between the various themes many of which were first brought to light by Edward Nelson In his writing and conversation Nelson has always emphasized and relished the human aspect of mathematical endeavor In his intellectual world there is no sharp boundary between the mathematical the cultural and the spiritual It is fitting that the final chapter provides a mathematical perspective on musical theory one that reveals an unexpected connection with some of the book s main themes

Optimal Transport for Applied Mathematicians Filippo Santambrogio,2015-10-17 This monograph presents a rigorous mathematical introduction to optimal transport as a variational problem its use in modeling various phenomena and its connections with partial differential equations Its main goal is to provide the reader with the techniques necessary to understand the current research in optimal transport and the tools which are most useful for its applications Full proofs are used to illustrate mathematical concepts and each chapter includes a section that discusses applications of optimal transport to various areas such as economics finance potential games image processing and fluid dynamics Several topics are covered that have never been previously in books on this subject such as the Knothe transport the properties of functionals on measures the Dacorogna Moser flow the formulation through minimal flows with prescribed divergence formulation the case of the supremal cost and the most classical numerical methods Graduate students and researchers in both pure and applied mathematics interested in the problems and applications of optimal transport will find this to be an invaluable resource

Recent Advances in the Theory and Applications of Mass Transport José-Francisco Rodrigues,2004 Contains both survey and research articles on methods of optimal mass transport and applications in physics   Noncommutative Geometry and Optimal Transport Pierre Martinetti,Jean-Christophe Wallet,2016-10-26 The distance formula in noncommutative geometry was introduced by Connes at the end of the 1980s It is a generalization of Riemannian geodesic distance that makes sense in a noncommutative setting and provides an original tool to study the geometry of the space of states on an algebra It also has an intriguing echo in physics for it yields a metric interpretation for the Higgs field In the 1990s Rieffel noticed that this

distance is a noncommutative version of the Wasserstein distance of order 1 in the theory of optimal transport More exactly this is a noncommutative generalization of Kantorovich dual formula of the Wasserstein distance Connes distance thus offers an unexpected connection between an ancient mathematical problem and the most recent discovery in high energy physics The meaning of this connection is far from clear Yet Rieffel s observation suggests that Connes distance may provide an interesting starting point for a theory of optimal transport in noncommutative geometry This volume contains several review papers that will give the reader an extensive introduction to the metric aspect of noncommutative geometry and its possible interpretation as a Wasserstein distance on a quantum space as well as several topic papers **Traffic Networks as Information Systems** Jean-Pierre Aubin,Anya Désilles,2016-07-13 This authored monograph covers a viability to approach to traffic management by advising to vehicles circulated on the network the velocity they should follow for satisfying global traffic conditions It presents an investigation of three structural innovations The objective is to broadcast at each instant and at each position the advised celerity to vehicles which could be read by auxiliary speedometers or used by cruise control devices Namely 1 Construct regulation feedback providing at each time and position advised velocities celerities for minimizing congestion or other requirements 2 Taking into account traffic constraints of different type the first one being to remain on the roads to stop at junctions etc 3 Use information provided by the probe vehicles equipped with GPS to the traffic regulator 4 Use other global traffic measures of vehicles provided by different types of sensors These results are based on convex analysis intertemporal optimization and viability theory as mathematical tools as well as viability algorithms on the computing side instead of conventional techniques such as partial differential equations and their resolution by finite difference or finite elements algorithms The target audience primarily covers researchers and mathematically oriented engineers but the book may also be beneficial for graduate students **Non-Smooth and Complementarity-Based Distributed Parameter Systems** Michael Hintermüller,Roland Herzog,Christian Kanzow,Michael Ulbrich,Stefan Ulbrich,2022-02-18 Many of the most challenging problems in the applied sciences involve non differentiable structures as well as partial differential operators thus leading to non smooth distributed parameter systems This edited volume aims to establish a theoretical and numerical foundation and develop new algorithmic paradigms for the treatment of non smooth phenomena and associated parameter influences Other goals include the realization and further advancement of these concepts in the context of robust and hierarchical optimization partial differential games and nonlinear partial differential complementarity problems as well as their validation in the context of complex applications Areas for which applications are considered include optimal control of multiphase fluids and of superconductors image processing thermoforming and the formation of rivers and networks Chapters are written by leading researchers and present results obtained in the first funding phase of the DFG Special Priority Program on Nonsmooth and Complementarity Based Distributed Parameter Systems Simulation and Hierarchical Optimization that ran from 2016 to 2019 Conversations on Optimal Transport Luigi

Ambrosio,Alfio Quarteroni,2024-05-23 This work is closely tied to the renowned mathematics textbook series known as UNITEXT tailored for university students pursuing bachelor s or master s degrees What sets this particular book apart in the Springer collection is its unique origin it has been crafted through a meticulous process involving interviews handled with and by world class mathematicians The content featured in this book revolve around a highly relevant and engaging topic Optimal Transport These conversations involve not only authors from the UNITEXT series but also members of the series Editorial Board Additionally they feature prominent figures in the field including a Field Medalist This work provides readers with a snapshot of remarkable vitality and freshness guaranteed to captivate and engage anyone with an interest in mathematics It s important to note that these interviews were initially shared as podcasts and originally broadcasted as online events on the Cassyni platform Subsequently advanced AI tools were employed under human supervision to transcribe the audios and edit them for better readability A human copy editor was involved during the whole process and the authors revised the final copy edited texts before publication The content in each format the interviews the PODCASTS and the book is self contained and not a mere adaptation from one medium to another Instead it represents an independent exploration of the subject matter

Adopting the Melody of Appearance: An Emotional Symphony within **Optimal Transportation Theory And Applications Cedric Villani**

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