Titles and abstracts

• August 8

Lihe Wang (Jiao Tong University & University of Iowa)

Geometry and analysis for elliptic equations

We will give a geometric description for some of the estimates for elliptic equations that developed in last few decades. Few examples of these ideas are the connection of L^p spaces and Hölder spaces, maximal functions and the tangential paraboloids, functions and their Fourier transforms, etc. All these are fitted in the idea of pictures to estimates and vice versa.

Nguyen Cong Phuc (Louisiana State University)

The Navier-Stokes equations in nonendpoint borderline Lorentz spaces

It is shown both locally and globally that $L_t^\infty(L_x^{3,q})$ solutions to the three-dimensional Navier-Stokes equations are regular provided $q \neq \infty$. Here $L_x^{3,q}$, $0 < q \leq \infty$, is an increasing scale of Lorentz spaces containing L_x^3. Thus the result provides an obvious improvement of a result by Escauriaza, Seregin and Sverák, which treated the case $q = 3$. A new local energy bound and a new ϵ-regularity criterion are combined with the backward uniqueness theory for parabolic equations to obtain the result.

Shulin Zhou (Peking University)

Existence and uniqueness of weak solutions for 2D low-curvature equation

In this work we establish the existence and uniqueness of weak solutions for the initial-boundary value problem of a two-dimensional low-curvature equation, which is related to image analysis

Christoph Scheven (University of Duisburg-Essen)

The heat flow for surfaces of prescribed mean curvature

We consider the heat flow associated to the system for surfaces of prescribed mean curvature, more precisely

$$\partial_t u - \Delta u = -2(H \circ u) D_1 u \times D_2 u \qquad \text{in } B^2 \times (0, \infty),$$

for a given function $H : \mathbb{R}^3 \to \mathbb{R}$ and $u : B^2 \times (0, \infty) \to \mathbb{R}^3$.

The most general assumption under which existence is known in the elliptic case is an isoperimetric condition on the prescribed mean curvature function

H. Under the same condition, we construct a solution to the parabolic problem with prescribed Cauchy-Dirichlet boundary data. The solution exists for all times and sub-converges to a solution of the stationary problem as time tends to infinity. Moreover, we show that the solution can be constructed in such a way that it develops singularities at most at finitely many times.

All results were established in joint works with Verena Bögelein and Frank Duzaar.

Eun Kyoung Lee (Pusan National University)

Positive radial solutions on exterior domains with nonlinear boundary conditions

The problem for the positive radial solution of the steady state reaction diffusion equation on an exterior domain with a nonlinear boundary condition on the interior boundary can be translated to positive solutions of the two point boundary value problem with nonlinear boundary condition at one boundary point. In this talk, I introduce some results for the existence and multiplicity results via the method of sub-super solutions and also discuss some uniqueness results.

Myoungjean Bae (POSTECH)

Degenerate elliptic equations related to Prandtl-Meyer reflection

Prandtl (1936) first employed the shock polar analysis to show that, when a steady supersonic flow impinges a solid wedge whose angle is less than a critical angle (i.e., the detachment angle), there are two possible configurations: the weak shock solution and the strong shock solution, and conjectured that the weak shock solution is physically admissible. The fundamental issue of whether one or both of the strong and the weak shocks are physically admissible has been vigorously debated over several decades and has not yet been settled in a definite manner. In this talk, I address this longstanding open issue and present recent analysis to establish the stability theorem for steady weak shock solutions as the long-time asymptotics of unsteady flows for all the physical parameters up to the detachment angle for potential flow.

In particular, this talk is focused on a priori estimates of solutions to second order nonlinear degenerate elliptic PDEs related to Prandtl-Meyer reflection problem.

This talk is based on collaboration with Gui-Qiang G. Chen (Univ. of Oxford) and Mikhail Feldman(UW-Madison).

[1] Bae, M., Chen, G.-Q. and Feldman, M., Regularity of solutions to regular shock reflection for potential flow, *Invent. Math.* **175** (2009), 505–543.

[2] Bae, M., Chen, G.-Q. and Feldman, M., Prandtl-Meyer reflection for supersonic flow past a solid ramp, Quarterly Appl. Math. (2013) no 3, 583–600.

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Seungjin Ryu (University of Seoul)

Weighted Orlicz estimates for general nonlinear parabolic equations over nonsmooth domains

We introduce a parabolic analogue of Muckenhoupt weights to study optimal weighted regularity in Orlicz spaces for a general nonlinear parabolic problem in divergence form of p-Laplacian type over nonsmooth domains. Assuming that the involved nonlinearity is merely measurable with respect to the time variable and has small BMO with respect to the spatial variables, the lateral boundary of the parabolic cylinder is δ-Reifenberg flat, and the associated weight belongs to a suitable parabolic Muckenhoupt class depending on a given Young function, we prove that the gradient of the weak solution is as globally integrable as the nonhomogeneous term in the weighted Orlicz space. In this direction, our results extend the existing regularity estimates in Lebesgue spaces, Orlicz spaces as well as weighted Lebesgue spaces to such weighted Orlicz spaces.

Chunqin Zhou (Jiao Tong University)

Existence results for mean field equation of the equilibrium turbulence in the super critical case

In the talk, I will concern with the mean field equation of the equilibrium turbulence on a compact Riemannian surface, which was introduced firstly by Joyce & Montgomery and Pointin & Lundgren by different statistical arguments in the 1970's. Combining some compact Theorems and a min-max scheme, I will give some existence results in the critical case under some geometry conditions of the surface. Furthermore, I will give the existence result in the super-critical case without any assumption on the topology and the geometry of the surface.

Yumi Cho (Seoul National University)

Global estimates for nonlinear obstacle problems

In this talk, we consider a nonhomogeneous obstacle problem involving a discontinuous nonlinearity over an irregular domain in divergence form of $p-$Laplacian type. We establish the global Calderón-Zygmund estimate by proving that the gradient of the weak solution is as integrable as both the gradient of the obstacle and the nonhomogeneous term under the BMO smallness of the nonlinearity and sufficient flatness of the boundary in the Reifenberg sense.

• August 9

Lubomira Softova (Seconda Universita di Napoli)

L^p-integrability of the gradient of solutions to quasilinear systems with discontinuous coefficients

We study the integrability properties of the weak solutions of the following Dirichlet problem

$$\begin{cases} D_\alpha\big(A_{ij}^{\alpha\beta}(x)D_\beta u^j(x) + a_i^\alpha(x,\mathbf{u})\big) = b_i(x,\mathbf{u},D\mathbf{u}) & \text{a.a. } x\in\Omega \\ \mathbf{u}(x) = 0 & \text{on } \partial\Omega \end{cases}$$

where $\Omega\subset\mathbb{R}^n$, $n\geq 2$ is a bounded *Reifenberg flat* domain. The principal coefficients are discontinuous with *small mean oscillation* (small BMO), satisfying in Ω

$$A_{ij}^{\alpha\beta}(x)\xi_\alpha^i\xi_\beta^j \geq \lambda|\xi|^2 \quad \forall\ \xi\in\mathbb{M}^{N\times n}, \quad \|A_{ij}^{\alpha\beta}\|_{\infty,\Omega}\leq M\,.$$

The non linear terms supposed to be Carathéodory functions and satisfy *controlled growth conditions*. Namely, for $|\mathbf{u}|,|\mathbf{z}|\to\infty$ we have

$$a_i^\alpha(x,\mathbf{u}) = \emptyset(\varphi_1(x)+|\mathbf{u}|^{\frac{n}{n+2}}) \quad \text{and} \quad b_i(x,\mathbf{u},\mathbf{z}) = \emptyset(\varphi_2(x)+|\mathbf{u}|^{\frac{n+2}{n-2}}) \qquad (1)$$

with $\varphi_1\in L^p(\Omega)$, $p>2$ and $\varphi_2\in L^q(\Omega)$, $q>\frac{2n}{n+2}$.

We show that the problem under consideration satisfies the Calderón–Zygmund property when Ω is (δ,R)-Reifenberg flat and the coefficients are (δ,R)-vanishing in Ω. Precisely, each bounded weak solution $\mathbf{u}\in W_0^{1,2}\cap L^\infty(\Omega;\mathbb{R}^N)$ gains better regularity from the data φ_1 and φ_2 and belongs to $W_0^{1,\min\{p,q^*\}}\cap L^\infty(\Omega;\mathbb{R}^N)$ where q^* is the Sobolev conjugate of q.

Similar result is obtained also for the Cauchy-Dirichlet problem for parabolic quasilinear systems.

Tuomo Kuusi (Aalto University)

A quantitative modulus of continuity for the two-phase Stefan problem

We will derive the quantitative modulus of continuity

$$\omega(r) = \left[p+\ln\left(\frac{r_0}{r}\right)\right]^{-\alpha}, \qquad \alpha\equiv\alpha(n,p) := \frac{p}{n+p}, \qquad p<n,$$

for solutions of the p-degenerate two-phase Stefan problem. Even in the classical case $p=2$, this represents a twofold improvement with respect to the early 1980's state-of-the-art results by Caffarelli-Evans and DiBenedetto, in the sense that we discard one logarithm iteration and obtain an explicit value for the exponent $\alpha(n,p)$. This is a joint work with P. Baroni and J.-M. Urbano.

Tong Li (University of Iowa)

Global wellposedness and traveling wave solutions of PDE models of chemotaxis

We investigate local and global existence, blowup criterion and long time behavior of classical solutions for a system of PDEs derived from the Keller-Segel model describing chemotaxis. Moreover, we establish the existence and the nonlinear stability of large-amplitude traveling wave solutions to the system of nonlinear conservation laws derived from Keller-Segel model.

Yannick Sire (Universite d'Aix-Marseille III)

Nonlocal phase transitions

I will review several recent results concerning phase transitions involving a nonlocal operator in the spirit of a conjecture by De Giorgi (in the local case). I will mention links with nonlocal minimal surfaces and open questions.

Martin Dindos (University of Edinburgh)

The stationary Navier-Stokes system in nonsmooth manifolds

We consider the linearized version of the stationary Navier-Stokes equations on a subdomain Ω of a smooth, compact Riemannian manifold M. The emphasis is on regularity: the boundary of Ω is assumed to be only C^1 and even Lipschitz, and the data are selected from appropriate Sobolev-Besov scales. Our approach relies on the method of boundary integral equations, suitably adapted to the variable coefficient setting we are considering here. Applications to the stationary, non-linear Navier-Stokes equations in this context are also discussed.

Hayk Mikayelyan (Xi'an Jiaotong-Liverpool University)

An elliptic equation with discontinuous coefficients on the level set and the Bellman equation

We prove a partial regularity result for the zero level set of a certain elliptic PDE with discontinuous coefficients at the zero level set. The proof uses some ideas from the geometric measure theory, which are being applied in the PDE context. The result is used to show the partial regularity of the phase-transition set of the Bellman equation with two elliptic operators.

Yong-Cheol Kim (Korea University)

Regularity results for nonlocal fully nonlinear equations

This result is a joint work with Ki-Ahm Lee. We prove the Evans-Krylov theorem for fully nonlinear equations formulated by parabolic integro-differential operators.

Deliang Xu (Jiao Tong University)

Regularity of dirac-harmonic maps with general potential by assuming integrability in Zygmmund space LlogL

We prove that weak solutions of Dirac-harmonic map with general potential from a compact two dimensional Riemannian manifold (with spin structure) into a general Riemannian manifold are smooth by assuming that the extra term (compare to the coupled equations of dirac-harmonic maps) belong to the Zygmmund space LlogL. Up to now, the condition we assume is optimal for the problem of regularity for dirac-harmonic maps with curvature potential.

Sukjung Hwang (University of Edinburgh)

Hölder continuity of a bounded weak solution of generalized parabolic p-Laplacian equations

Here we generalize quasilinear parabolic $p-$Laplacian type equations to obtain the prototype equation as

$$u_t - \operatorname{div}(g(|Du|)/|Du| \cdot Du) = 0,$$

where a nonnegative, increasing, and continuous function g trapped in between two power functions $|Du|^{g_0-1}$ and $|Du|^{g_1-1}$ with $1 < g_0 \leq g_1 < \infty$. Through this generalization in the setting from Orlicz spaces, we provide a uniform proof with a single geometric setting that a bounded weak solution is locally Hölder continuous considering $1 < g_0 \leq g_1 \leq 2$ and $2 \leq g_0 \leq g_1 < \infty$ separately. By using geometric characters, our proof does not rely on any of alternatives which is based on the size of solutions.

• August 10

Kin Ming Hui (Academia Sinica)

Asympoptic behavior of solutions of the higher dimensional logarithmic diffusion equation

I will discuss my recent result on the extinction behavior and large time behavior of the high dimensional logarithmic diffusion equation under various conditions on the initial value.

Panagiota Daskalopoulos (Columbia University)

Type II ancient compact solutions to the Yamabe flow

We will discuss the construction of new type II ancient compact solutions to the Yamabe flow which are rotationally symmetric and converge, as $t \to -\infty$, to a tower of two spheres. Their curvature operator changes sign. Our technique

may be viewed as a parabolic analogue of gluing two exact solutions to the rescaled equation, that is the spheres, with narrow cylindrical necks to obtain a new ancient solution to the Yamabe flow. The result generalizes to the gluing of k spheres for any $k \geq 2$. This is joint work with Manuel del Pino and Natasa Sesum.

Yoshie Sugiyama (Kyushu University)

Uniqueness theorem on weak solutions to the Keller-Segel system of degenerate and singular types

The Keller-Segel system contains several parameters which cause numerous structures such as linear, degenerate and singular type of PDE. In particular, the degenerate type contains the unknown function as the coefficients breaking down uniform ellipticity, which makes the problem more difficult in comparison with the other types. The Keller-Segel system itself is characterized as the parabolic- parabolic and parabolic-elliptic both of provide us an important research theme. Indeed, we need to handle these types in accordance with the characteristic features of equations. In this talk, we shall bring a focus onto the parabolic-parabolic and parabolic-elliptic Keller-Segel systems of the singular and degenerate types and show uniqueness of weak solutions in the class of Hölder continuous functions.

Futoshi Takahashi (Osaka City University)

Extremal solutions to Liouville-Gelfand type elliptic problems with nonlinear Neumann boundary conditions

We consider the Liouville-Gelfand type problem with nonlinear Neumann boundary condition, of which nonlinearity is smooth, positive, increasing, convex, and superlinear at infinity. In this talk, after introducing an appropriate notion of weak solutions to our problem, we discuss several properties of extremal solutions such as regularity, uniqueness, and the existence of weak eigenfunctions associated to the linearized extremal problem.

Xu-Jia Wang (Australian National University)

The L_p-Minkowski problem

The L_p-Minkowski problem is an extension of the classical Minkowski problem. It concerns the existence, uniqueness, and regularity of closed convex hypersurfaces with prescribed Gauss curvature. The Minkowski problem has been studied by many people in the last century and has been completely resolved. The p-Minkowski problem involves more applications. In this talk we will review the development of the study of the L_p-Minkowski problem and discuss some recent works on the problem.

Hyunsuk Kang (GIST)

Evolution of convex hypersurfaces by the square root of the scalar curvature with an anisotropic factor

We show the existence of a smooth solution for the flow deformed by the square root of the scalar curvature multiplied by a positive anisotropic factor given a strictly convex initial hypersurface in Euclidean space suitably pinched. The pinching estimate is obtained by modifying Andrews' result and the Moser iteration is used for the curvature estimate. In dimension two, it is shown that, with a volume preserving rescaling, the limit profile satisfies a soliton equation. This is a joint work with Lami Kim and Ki-Ahm Lee.

Lami Kim (Hokkaido University)

α-Gauss curvature flows with flat sides

In this talk, we introduce the deformation of the 2-dimensional convex surfaces in $\mathbb{R}^3$ whose speed at a point on the surface is proportional to the α-Gauss curvature K^α. For $1/2 < \alpha \leq 1$, there is smooth solution if the initial surface is smooth and strictly convex and there exists a viscosity solution with $C^{1,1}$-estimate before the collapsing time if the initial surface is only convex. We also show that the interface between the flat side and the strictly convex side of the surface remains smooth on $0 < t < T_0$ under certain necessary regularity and non-degeneracy initial conditions, where T_0 is the vanishing time of the flat side. This talk is based on joint work with K. Lee and E. Rhee.

Soojung Kim (NIMS)

Harnack inequality for nondivergent parabolic operators on Riemannian manifolds

The Krylov-Safonov Harnack inequality for uniformly elliptic operators on Riemannian manifolds was initiated by Cabré, which is based on the ABP type estimate. In this talk, I will discuss the Krylov-Safonov Harnack inequality for uniformly parabolic operators on certain Riemannian manifolds. This, in particular, gives a new nondivergent proof for the Li-Yau Harnack inequality of the heat equation on manifolds with nonnegative Ricci curvature. This is a joint work with Seick Kim and Ki-Ahm Lee.

• August 11

Yoshihiro Tonegawa (Hokkaido University)

A regularity theorem for Brakke's curvature flow of networks

The talk concerns a regularity problem on general Brakke's curvature flow of networks, which is a 1-parameter family of 1-dimensional sets on a plane. We

establish a local epsilon-regularity theorem in the neighborhood of triple junctions for the flow. Assuming that any static tangent flow is a unit density line or triple junction, we prove that the set of singularity is a closed set of parabolic Hausdorff dimension at most 1. Outside of the set of singularity, the flow is consisted of smooth curves joined by triple junctions with the angle of 120 degrees, all moving smoothly. This is a joint work with Neshan Wickramasekera.

Juan Luis Vazquez (Universidad Autnoma de Madrid)

Nonlinear diffusion with fractional Laplacian operators

Much recent research is taking place in the area of elliptic and parabolic equations, aimed at understanding the effect of replacing the Laplace operator, and its usual variants, by a fractional Laplacian operator or other similar nonlocal operators, which represent long distance interactions. Linear and nonlinear models are involved. The lecture will describe some of the progress made by the author and collaborators on the topic of nonlinear fractional heat equations, in particular when the nonlinearities are of porous medium and fast diffusion type.

Seick Kim (Yonsei University)

Green's function for elliptic and parabolic systems with discontinuous coefficients

I will describe how to construct Green's function for second-order elliptic and parabolic systems in divergence form with bounded measurable coefficients subject to various boundary conditions. We assume that weak solutions of the systems is locally Hölder continuous but do not make any explicit smoothness assumption on the coefficients and thus allow discontinuous coefficients I will also discuss how to obtain a global bound for Green's function.

James McCoy (University of Wollongong)

Fully nonlinear curvature flow of axially symmetric hypersurfaces

Inspired by earlier results on the mean curvature flow, and recent investigations of fully nonlinear curvature flow of closed hypersurfaces that are not convex, we consider contraction of axially symmetric hypersurfaces by convex, degree-one homogeneous fully nonlinear functions of curvature. With a natural class of Neumann boundary conditions, we show that evolving hypersurfaces exist for a finite maximal time. The maximal time is characterised by a curvature singularity at either boundary. Some results continue to hold in the cases of mixed NeumannDirichlet boundary conditions and more general curvature-dependent speeds. In the case of pure Neumann boundary conditions we can remove the convexity condition on the speed and also show that the curvature singularity is Type I. This is joint work with Fatemah Mofarreh, Graham Williams and Valentina-Mira Wheeler.

Matteo Bonforte (Universidad Autnoma de Madrid)

A Priori Estimates for Fractional Nonlinear Degenerate Diffusion Equations on bounded domains

We investigate quantitative properties of nonnegative solutions $u(t,x) \geq 0$ to the nonlinear fractional diffusion equation, $\partial_t u + \mathcal{L}(u^m) = 0$, posed in a bounded domain, $x \in \Omega \subset \mathbb{R}^N$ for $t > 0$ and $m > 1$. As $\mathcal{L}$ we can take the most common definitions of the fractional Laplacian $(-\Delta)^s$, $0 < s < 1$, in a bounded domain with zero Dirichlet boundary conditions, as well as more general classes of operators. We consider a class of very weak solutions for the equation at hand, that we call weak dual solutions, and we obtain a priori estimates in the form of smoothing effects, absolute upper bounds, lower bounds, and Harnack inequalities. We also investigate the boundary behaviour and we obtain sharp estimates from above and below. The standard Laplacian case $s = 1$ or the linear case $m = 1$ are recovered as limits. The method is quite general, suitable to be applied to a number of similar problems that will be briefly discussed as examples. As a consequence, we can prove existence and uniqueness of minimal weak dual solutions with data in $L^1_{\Phi_1}$, where Φ_1 is the first eigenfunction of $\mathcal{L}$. We also briefly show existence and uniqueness of H^{-s} solutions with a different approach. As a byproduct, we derive similar estimates for the elliptic semilinear equation $\mathcal{L}S^m = S$ and we prove existence and uniqueness of $H^{-s}(\Omega)$ solutions via parabolic techniques. Solutions to this elliptic problem represents the asymptotic profiles of the rescaled solutions, namely the stationary states of the rescaled equation $\partial_t v = -\mathcal{L}(v^m) + v$. Finally, we will study the asymptotic behaviour. We will prove sharp rates of decay of the rescaled solution to the unique stationary profile S and also for the relative error $v/S - 1$. The sharp rates of convergence can be obtained with two different methods: one is based on the above estimates, that guarantee existence of the "friendly giant". Another approach is given by a new entropy method, based on the so-called Caffarelli-Silvestre extension. This is a joint work with J. L. Vzquez (UAM, Madrid, Spain) and Y. Sire (Univ. Marseille, France).

References:

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[**BV2**] M. B., J. L. Vazquez, Nonlinear Degenerate Diffusion Equations on bounded domains with Restricted Fractional Laplacian. In Preparation (2014).

Werner Varnhorn (Kassel University)

On optimal initial value conditions for strong solutions of the Navier-Stokes equations

Let $[0,T)$ with $0 < T \leq \infty$ be a time interval and $\Omega \subseteq \mathbb{R}^3$ a smoothly bounded domain. Consider in $[0,T)\times\Omega$ the non-stationary nonlinear Navier-Stokes equations with prescribed initial value $u_0 \in L^2_\sigma(\Omega)$ and external force $f = \nabla \cdot F$ with $F \in L^2(0,T;L^2(\Omega))$. It is well-known that there exists at least one weak solution of the Navier-Stokes system in $[0,T)\times\Omega$ in the sense of Leray-Hopf. Since we do not know if these solutions are unique it is an important problem to investigate conditions on the data u_0 and f - as weak as possible - to guarantee the existence of a unique strong solution $u \in L^s(0,T;L^q(\Omega))$ satisfying Serrin's condition $\frac{2}{s}+\frac{3}{q} = 1$ with $2 < s < \infty$, $3 < q < \infty$, at least for $T > 0$ sufficiently small. During the last years several sufficient conditions have been given, yielding step by step a larger class of corresponding local strong solutions. These conditions, however, need not to be necessary, in contrast to our result which is optimal in a certain sense and yields the largest possible class of such local strong solutions.

References

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Daniel Hauer (University of Sydney)

Uniform convergence of solutions to elliptic equations on domains with shrinking holes

In this talk I want to present new results which I established during my postdoc year at the University of Sydney under the supervision of EN Dancer and D Daners. I consider solutions of the Poisson equation on a family of domains

with holes shrinking to a point. This kind of domain convergence is very singular. Assuming Robin or Neumann boundary conditions on the boundary of the holes, I show that the solution converges uniformly to the solution of the Poisson equation on the domain without the holes. This is in contrast to Dirichlet boundary conditions where there is no uniform convergence. The results substantially improve earlier results on L^p-convergence.

Minha Yoo (NIMS)

A drift approximation for qusi-linear parabolic PDEs with oblique boundary data

We consider the following qusi-linear parabolic PDE with oblique boundary data in a bounded and smooth domain:

$$\begin{cases} u_t - \operatorname{tr}\left(A(u,x,t)\, D^2 u\right) = 0 & \text{in } \Omega \times (0,T), \\ (A(u,x,t)\nu) \cdot Du = 0 & \text{on } \partial\Omega \times (0,T), \\ u(x,0) = u_0(x) & \text{on } \Omega \times \{0\}. \end{cases}$$

We approximate the solution by solutions of PDEs defined in the whole domain with penalizing drift terms. The motivation of this approximation and the convergence speed will be discussed. This is a joint work with Prof. Inwon-Kim.

• August 12

Natasa Sesum (Rutgers University)

Singularity formation in the Yamabe flow

In the talk we will discuss the asymptotics of Yamabe solitons. We also give some sufficient conditions which guarantee the singularity formation is described by one of the Yamabe solitons. This is a joint work with Daskalopoulos and King.

Robert McCann (University of Toronto)

Optimal transport: old and new

The Monge-Kantorovich optimal transportation problem is to pair producers with consumers so as to minimize a given transportation cost. When the producers and consumers are modeled by probability densities on two given manifolds or subdomains, it is interesting to try to understand the analytical, geometric and topological features of the optimal pairing as a subset of the product manifold. This subset may or may not be the graph of a map.

This lecture describes recent developments concerning Monge's original version of this problem, and contrasts them with a capacity constrained variant in

which a bound is imposed on the quantity transported between each given producer and consumer. In particular, we give a new perspective on Kantorovich's linear programming duality and expose how more subtle questions relating the structure of the solution are intimately connected to the differential topology and geometry of the chosen transportation cost.

Zhongwei Shen (University of Kentucky)

Convergence rates in almost-periodic homogenization

In the theory of homogenization one is trying to describe the macroscopic properties of microscopically heterogeneous media with rapidly oscillating microstructure, such as composite material. In this talk we will discuss some recent work on quantitative homogenization of second-order elliptic systems in divergence form with rapidly oscillating almost-periodic coefficients. We obtain estimates for approximating correctors in terms of a function that quantifies the almost periodicity of the coefficients. The results are used to investigate the problem of convergence rates.