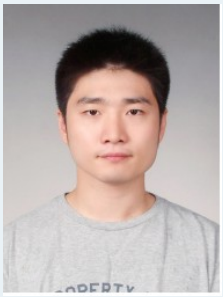
HYO SEOK JANG, Ph.D.

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RESEARCH & COLLABORATION PROFILE

KEY WORDS: Partial Differential Equations, Geometric Analysis, Mathematical Economics



Research Snapshot. Doctor Jang studies nonlinear partial differential equations of elliptic and parabolic types and related geometric flows by methods of regularity theory and singularity analysis. His particular interest is in the curvature flows with free boundaries and singularities; these types of equations are analyzed by the tools for degenerate parabolic equations. Also, he works on the stability of nonlinear parabolic equations and their global attractors. Another area of his research is general equilibrium theory in mathematical economics; he uses fixed point theory in functional analysis, relaxation of functionals, normal cones to investigate economies with a continuum of agents, a non-compact set of commodities in an infinite-dimensional space, and non-convex preferences.

RESEARCH EXPERTISE

- **Nonlinear elliptic and parabolic partial differential equations:** Schauder estimates, Aleksandrov-Bakelman-Pucci (ABP) Maximum Principle, Krylov-Safonov theory for equations in non-divergence form for geometric regularity
- **Flows evolving by curvature:** speed control of free boundary propagation, local analysis of free boundaries, Bernstein's method, curvature estimates, all-time existence of flows up to free boundaries
- **Ricci flows and Yamabe flows:** energy and entropy functionals, conformal metrics, volume control, stability of evolution of metrics
- **Harmonic maps:** partial regularity, local energy analysis, blowups and singularities, convergence of flows
- **Global attractors of nonlinear equations:** existence, upper and lower semicontinuity of global attractors
- **Economies and games with a continuum of agents:** relaxation of non-convex functionals, saturated spaces of agents, non-convex preferences, externalities, Banach spaces of commodities.

RECENT RESEARCH HIGHLIGHTS

- **Global attractors of p(x)-laplacian equations on unbounded domains (preprint 2026):** obtained existence and upper semicontinuity of global attractors
- **Scalar curvature flow with a flat side (preprint 2026):** obtained gradient estimates and curvature estimates by Bernstein's technique near the free boundary, and proved the all-time existence by Krylov-Safonov method.
- **Degenerate partial differential equations (preprint 2026):** showed Schauder estimates for existence and Aleksandrov-Bakelman-Pucci (ABP) for Hölder regularity of degenerate equations
- **Coupling of a Yamabe flow and a harmonic map flow (CAG 2025):** used a priori Schauder estimates to prove the short-time existence of the system of two flows, also proved the long-time existence of the system when the system is perturbed from a steady state.
- **Existence of general equilibrium in an economy (EL 2025):** used relaxation in functional analysis to show the existence of equilibria in economics with a non-atomic measurable space of agents with non-convex preferences and an infinite-dimensional commodity space.

POTENTIAL COLLABORATION RESEARCH

Best-fit collaborator areas: Analysis of PDEs | Geometric analysis | Differential Geometry | Dynamical systems | Applied mathematics | Mathematical Economics

- **1. Nonlinear partial differential equations:** Schauder estimates and short-time existence, Hölder regularity, and long-time existence,
- **2. Geometric flows and manifolds:** flows with free boundaries and singularities, gradient and curvature estimates, stability analysis, and convergence under perturbations.
- **3. Free boundaries and singularities:** speed control of free boundaries, regularity of free boundaries, measure control, gradient and curvature estimates of free boundaries, and singularity control.
- **4. Dynamical systems and PDEs:** global attractors of nonlinear partial differential equations, existence, and continuity of attractors.
- **5. Large economics and games:** economics and games with infinitely many agents, mean field games, stochastic control, non-convex optimization, and non-compact optimization.

SELECTED RECENT PUBLICATIONS

- Hyo Seok Jang, Ki-Ahm Lee & Woongbae Park, *Conformal heat flow of maps under Yamabe flow of metrics,* Communications in Analysis and Geometry, pp. 2153-2203, Volume 33 (2025) Number 9.
- Hyo Seok Jang, Sangjik Lee, *Equilibria in a large economy with externalities, non-convex preferences and an infinite-dimensional commodity space via relaxation,* Economics Letters, Article 112086, Volume 246 (2025)
- Hyo Seok Jang, Sangjik Lee, *Equilibria in a large production economy with an infinite dimensional commodity space and price dependent preferences,* Journal of Mathematical Economics, pp.57-64, Volume 90 (2020)

CONTACT

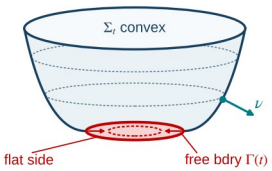
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REPRESENTATIVE RESEARCH FIGURES / SCHEMES

Flat-Side Curvature Flow

$\frac{\partial}{\partial t}X(x,t) = -k(x,t)\,\nu(x,t)$



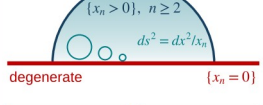
k: curvature, ν: outward normal

Bernstein estimates near $\Gamma(t)$

Krylov–Safonov: all-time existence

Degenerate PDEs

$u_t = x_n a^{nn} D_{nn} u + 2\sqrt{x_n}\, a^{in} D_{in} u$
$+ a^{ij} D_{ij} u + b^1 D_1 u + b^i D_i u, \quad i,j < n$

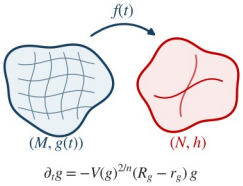


Schauder $C_s^{2+\alpha}$ ⇒ existence

ABP ⇒ Harnack ⇒ Hölder C_s^{α}

Yamabe–Harmonic Map Flow

$\partial_t f = \tau_g(f) = \Delta_g f + A_g(f)(df, df)$

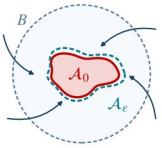


$\partial_t g = -V(g)^{2/n}(R_g - r_g)\,g$
$-\frac{1}{2}V(g)\,|df|_g^2\,g$

short- & long-time existence

Global Attractors

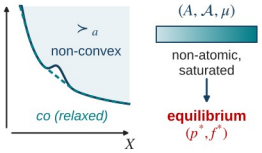
$u_t - \Delta_{p(x)}u + f(x,u) = g$



$\mathrm{dist}(\mathcal{A}_\varepsilon, \mathcal{A}_0) \to 0$

upper semicontinuity, unbounded domains

Large Economies



$\int_A F\,d\mu = \int_A \mathrm{co}\,F\,d\mu$

Banach commodity space, non-convex preferences