Uzawa, Tohru Professor

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Membership of academic societies:
BSP (The Biophysical Society of Japan),
SMF (Société Mathématique de France)

Research Interest:

- Representation Theory of Groups
- Compactifications
- Applied Mathematics

Research Summary:

Representation theory of groups is a relative new-comer to mathematics: it started with a paper by Frobenius titled "On the theory of group characters" in 1887. It was first a theory of characters, and it was Schur that formulated the results in terms of representations, namely homomorphisms from a group G to the general linear group $GL(V)$.

Representation developed rapidly, and is crucial to many fields in mathematics, physics, and applications.

The most natural way to produce examples of groups is to look at the group of symmetries preserving a structure. For example, one can take a vector space V over a finite field $\mathbb{F}_q$ and look at the group of linear isomorphisms. This is a finite group which is almost a simple group. Simple groups are the fundamental building blocks in group theory, and one interesting fact is that all but finitely many simple groups arise as groups preserving a geometry, and thus can be classified using Dynkin diagrams. Dynkin diagrams classify simple compact Lie groups; this is yet another example of the continuity joining finite groups and simple groups over various fields.

I have worked on real groups, and introduced a geometric method to give Matsuki correspondencees ([1]). I am also working on the use of covariant compactifications of group varieties and its applications to representation theory [2], and symmetric varieties over fields of arbitrary characteristics [1].

I am now also working on problems that arise from industry and medical research. Recent progress in stem cell research offers various interesting mathematical problems: the field is far from mature, and novel mathematical methods may arise from such research.

Major Publications:

[1] T. Uzawa: Symmetric varieties over arbitrary fields , C. R. Acad. Sci. Paris Sér. I Math. **333** (2001), no. 9, 833–838,

[2] T. Uzawa: Compactifications of symmetric varieties and applications to representation theory, Sūrikaisekikenkyūsho Kōkyūroku **10826** (1999), 137–142.

[3] Inui, N. and Katori, M. and Uzawa, T.: Duality and universality in non-equilibrium lattice models, J. Phys. A **28** (1995), no. 7, 1817–1830.

[4] Mirković, I. and Uzawa, T. and Vilonen, K.: Matsuki correspondence for sheaves, Invent. Math. **109**(1992) no. 22, 231–245.

[5] T. Yamada, H.Akamatsu, S. Hasegawa, N. Yamamoto, T.Yoshimura, Y.Hasebe, Y. Inoue, H. Mizutani, T.Uzawa, K. Matsunaga, S. Nakata: Age-related changes of p75 Neurotrophin receptor-positive adipose-derived stem cells, J. of Dermatological Science **58** (2010), no. 1, 36–42.

Education and Appointments:

1990 Assistant Professor, Penn State
1991 Assistant Professor, Tokyo University
1992 Associate Professor, Tohoku University
1997 Associate Professor, Rikkyo University
2002 Professor, Nagoya University

Message to Prospective Students:

The interplay between theory of groups and representation theory is fascinating, and the connection with automorphic forms is one of the most tantalizing connections to be found in mathematics. I prefer to work with geometric methods, a student should have strong background in differential geometry and algebraic geometry. My work in applied fields are scattered, but work related to stem cells are starting to take form; this is a rapidly progressing field, and it is hard to say what are the basic mathematical tools.

[1] I.M.Gelfand, M.I. Graev, I. Piatetski-Shapiro, Representation theory and automorphic functions.

[2] R.Hartshorne: Algebraic geometry.

[3] D. Vogan: Unitary Representations of Reductive Lie Groups

[4] D. MacKay:Information Theory, Inference, and Learning Algorithms. http://www.inference.phy.cam.ac.uk/itprnn/book.html

[5] W.Fulton: Intersection theory.