

Research plan (Mikiya Masuda) January, 2023

I would like to regard toric topology widely as mathematics related to torus actions and extend and deepen this area. Currently, I am working on the following projects.

(1) Research on mathematics related to Hessenberg varieties which are subvarieties of flag varieties. Together with Hiraku Abe, Megumi Harada, Tatsuya Horiguchi, I worked on the cohomology rings of Hessenberg varieties during this decade. It turned out that this work is related to hyperplane arrangements and Stanley- Stembridge conjecture on graph theory. My goal is to solve the Stanley-Stembridge conjecture and I have been working with Takashi Sato for two years to aim the solution of the conjecture. So far, we obtained results on

- (1) Characterization of regular semisimple Hessenberg varieties with cohomology rings generated in degree 2.
- (2) Relation between the twins of regular semisimple Hessenberg variety and unicellular LLT polynomials.

I am planning to deepen the research in this direction and reach the solution of Stanley-Stemberidge conjecture.

(2) I have been working on torus orbit closures in flag varieties with Eunjeong Lee and Seonjeong Park for these five years and will continue this project. Recently, Gaetz posted a preprint on arXiv where he solved the conjecture of Lee and myself. I am planning to understand his idea and deepen the research of the torus orbit closures.