Report on My TFS Guest Professorship Research Visit to UiT in April 2024

I visited UiT's Department of Mathematics and Statistics for three weeks in April 2024. During the stay, I gave a lecture series on topics in CR geometry and had many productive research discussions with mathematicians at the department. Further highlights of the trip include learning pickleball with the thriving local pickleball club and touring some of the impressive natural scenery in Tromsø's surrounding region.

As part of the visit, I gave a three-part lecture series titled *Connecting Intrinsic and Extrinsic Studies of 2-nondegenerate CR Geometries*. This included a broad introduction to 2-nondegenerate CR hypersurface geometry, and we covered several recent results on the intrinsic hypersurface geometry studied via general forms of their defining equations (i.e., an extrinsic viewpoint). As one of my primary research interests, it was a sincere pleasure to present lectures on this topic, and I am grateful to the UiT group for their engagement with the series and the many related mathematical discussions we had during my stay.

Several mathematical discussions with Dennis The, Boris Kruglikov, Henrik Winther, Omid Makhmali, and Eivind Schneider were quite edifying to me, and uncovered research topics that are well suited for ongoing collaboration. My discussions with Dennis The were on a relationship between certain CR geometries and a class of parabolic contact geometries. The latter class is a special case of structures studied in

- The, D. (2018). Exceptionally simple PDE. *Differential Geometry and its Applications*, 56, 13-41

and its relationship to CR structures arises from the construction in

- Sykes, D., & Zelenko, I. (2023). On geometry of 2-nondegenerate CR structures of hypersurface type and flag structures on leaf spaces of Levi foliations. *Advances in Mathematics*, 413, 108850

whereby reductions of contact geometries are naturally equipped to a CR hypersurface's Levi leaf space. Research questions we are investigating include determining which flat parabolic contact geometries arise from CR structures via this construction, and subsequently finding the relationship between the respective structures' symmetries and local invariants. With Boris Kruglikov and Henrik Winther, we discussed a correspondence between 2-nondegenerate CR hypersurface structures and certain scalar PDE systems. Applying this duality and using Maple to compute PDE symmetries, we explored the structure of symmetry algebras for several fairly new examples of homogeneous CR hypersurfaces. These discussions made my visit a genuine pleasure, and I look forward to future collaboration with the UiT group.