Project 5.2. “SCREAM1 : Study of geometric robots and notions of contactifications"

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www of the unit / project: www.cft.edu.pl

Background:

The PhD Scholarship will be financed by the GRIEG project "SCREAM: Symmetry, Curvature Reductions and EquivAlence Methods", which will be carried out as a collaboration between research teams in Warsaw, Poland and Tromso, Norway.

This is a research project in pure mathematics, specifically in differential geometry. For more than a century this area was dominated by Riemannian geometry, which is a curved version of Euclidean geometry familiar from school. There is an abundance of other geometries based on different notions than distance, such as, conformal geometries (angles), geometries of constraint velocities (nonholonomic mechanics), of differential equations (evolutionary dynamics), etc. Some of these geometries find applications in alternative theories of gravity and other physical theories, but the majority existed as mathematical abstractions.

These structures will be examined along the lines of the central themes of the SCREAM proposal: Symmetry, Curvature Reduction, and EquivAlence Methods.

Symmetry is fundamental in all natural sciences and is tantamount to niceness of the geometric structure. Curvature is a mathematical counterpart of gravity and it is a mechanism of reduction of symmetry. Equivalence is a way to align seemingly different geometric structures, and there exist various methods for this purpose.

The project requires learning methods from differential geometry, from Lie theory, and symbolic computer calculation skills. As part of the PhD training, international research visits are planned.

Aim:

The goal of the project is to implement and refine the techniques of Cartan geometries in order to answer questions of fundamental importance for a variety of geometric structures beyond the classical setting. In particular, this concerns investigating geometric robots whose configuration spaces support interesting geometric structures, investigating parabolic contact structures and notions of contactification, and establishing existence of solutions to physically motivated equations.

Requirements:

- solid background in differential geometry
- familiarity with Lie groups and Lie algebras
- willingness to collaborate and work in a team