An introduction to AdS geometry

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ABSTRACT

AdS geometry is the analog of hyperbolic geometry in Lorentzian setting. Many deep connections with hyperbolic geometry and Teichmueller theory are known in low dimension. We will provide a brief introduction on the subject highlighting those connections. More precisely in the first lecture we will introduce the model and its isometry group. In the second lecture I will talk about Mess' classification of the so called Maximal Globally Hyperbolic AdS spacetimes in dimenion 3. Those spaces, which are somehow analogue of quasi-Fuchsian manifolds, plays an imporatnt role in the theory. Finally in the last lecture I will introduce a Gauss map, which is a sort of bridge between the Lorentzian manifold and the symmetric space associated to its isometry group. As an applcation, follwoing Mess, we will give a Lorentzian proof of the celebrated Thurston's Earthquake theorem.

Introduction to the large scale geometry of nilpotent and solvable Lie groups

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ABSTRACT

The goal of these talks is to introduce students to the basics of large scale geometry and metric structures of nilpotent and solvable Lie groups. The first lecture will review the notion of quasi-isometry and gives basics of nilpotent and solvable groups. The second will focus on aspects of the metric geometry of nilpotent Lie groups. The third will look at the metric geometry of certain family of solvable Lie groups. We will assume some familiarity with Riemannian geometry and the basic definitions of Lie groups and Lie algebras.

From ping-pong in the Grassmannian to Anosov representations

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ABSTRACT

This series of lectures is intended as a gentle introduction to the Anosov property. Anosov-ness is a family of dynamical conditions for representations of word-hyperbolic groups into PGL_n (or more generally, into a semi-simple Lie group). Anosov-ness is stable under small deformations; it can be seen as a higher-rank analogue and generalization of convex-cocompactness.

The first lecture will focus on Schottky groups and their actions on the hyperbolic plane, which satisfy a "ping-pong" property governing the dynamics. In the second lecture I will describe how to define analogous conditions for a free group acting on the Grassmannian of k-planes in R^d. The main tool will be the Cartan decomposition (principal directions, principal values) and its "generic" behavior under composition of maps. This will count as motivation for the general Anosov condition, discussed in the 3rd talk, which can be seen as a kind of "diffuse" ping-pong behavior when moving on from free groups to word hyperbolic groups.

Beyond basic linear algebra I will only assume some working familiarity with coarse hyperbolic geometry; in particular, no dynamical or Lie-theoretic background is required.

Hyperbolicity and mapping class groups

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ABSTRACT

The coarse structure of the mapping class group of a surface can be understood in terms of its action on a family of hyperbolic spaces called curve complexes. This is a fundamental example of the notion of a hierarchically hyperbolic group. We will develop some of the basic tools for analyzing and using this kind of structure, focusing on a "Realization Theorem", and its application to understanding some of the coarse cubical structure of the group.