Seminário de Geometria

Isometric Immersions of Pseudo-Spherical Surfaces via
PDEs Speaker: Nabil Kahouadji

ABSTRACT: Pseudo-spherical surfaces are surfaces of constant negative Gaussian curvature. A way of realizing such a surface in 3d space as a surface of revolution is obtained by rotating the graph of a curve called tractrix around the z-axis (infinite funnel). There is a remarkable connection between the solutions of the sine-Gordon equation $u_{xt} = \sin u$ and pseudo-spherical surfaces, in the sense that every generic solution of this equation can be shown to give rise to a pseudo-spherical surface. Further- more, the sine-Gordon equation has the property that the way in which the pseudo-spherical surfaces corresponding to its solutions are realized geometrically in 3d space is given in closed form through some remarkable explicit formulas. The sine-Gordon equation is but one member of a very large class of differential equations whose solutions likewise define pseudo-spherical surfaces. These were defined and classified by Chern, Tenenblat and others, and include almost all the known examples of "inte- grable" partial differential equations. This raises the question of whether the other equations enjoy the same remarkable property as the sine-Gordon equation when it comes to the realization of the corres- ponding surfaces in 3d space. We will see that the answer is no, and will provide a full classification of hyperbolic and evolution equation. The classification results will show, among other things, that the sine-Gordon equation is quite unique in this regard amongst all integrable equations.

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