INFINITE DIMENSIONAL LIE GROUPS AND THE KADOMTSEV-PETVIASHVILI HIERARCHY OF DIFFERENTIAL EQUATIONS

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ALTENCOA8-2018
Popayán, Colombia
23 al 27 de julio de 2018

RESUMEN. In this talk I will summarize some recent work on infinite dimensional Lie groups of relevance for Integrable Systems. Specifically, I am interested in the Kadomtsev-Petviashvili (KP) hierarchy of equations which is constructed as follows:

Let $P = \sum_{-\infty<n}^{N} a_n(x, t_1, t_2, \cdots)\partial_x^n$ be a formal pseudo-differential operator, and set up the equation

$$P_{t_n} = [(P^n)_+, P]$$

for $n = 1, 2, 3, \cdots$, in which $(P^n)_+$ indicates the projection of P^n on the space of *differential* operators. This equation translates into an infinite number of nonlinear equations for the coefficients a_n of P.

I will show that one can solve *all* the equations of the hierarchy using a factorization of an infinite dimensional Lie group of pseudo-differential operators. This result can be seen in several contexts:

- *Algebraic*: formal pseudo-differential operators are defined on (not necessarily commutative) algebras equipped with derivations, and the group is a formal object.

- *Geometric*: formal pseudo-differential operators are defined on algebras equipped with a Frölicher (or Fréchet) structure, and the group is a Frölicher Lie group.

- *Analytic*: pseudo-differential operators are not formal, and the group is a bona-fide Frölicher group of pseudo-differential operators.

This work is based on the following papers [1], [2], [3], [4]:

Agradecimientos. Universidad de Santiago de Chile.

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Key words and phrases. - Palabras clave y frases: Lie groups, pseudo-differential operator.
Álgebra, Aplicaciones.

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