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## A Talk at the 2nd ISNMP Conference

Bad Ems, 28 June to 4 July 2026

### Regular Session:

**Speaker: Roman Popovych** (Silesian University in Opava, Czech Republic, & Institute of Mathematics of NAS of Ukraine, Kyiv, Ukraine) )

**Title:** *Classical symmetry analysis of differential equations revisited*

**Abstract:** We discuss the rethinking of the foundations of classical symmetric analysis of differential equations that has been carried out over the past two decades. This mainly includes point transformations of differential equations and structures constituted by such transformations.

First we concentrate on point symmetries of differential equations, distinguishing continuous and discrete ones, and the methods of their computation. Common misconceptions in interpreting point symmetries and errors in their computation are analyzed. The main illustrative example is given by the (1+1)-dimensional linear heat equation. We derive a nice representation for its point symmetry transformations and properly interpret them. This allows us to prove that the pseudogroup of these transformations has exactly two connected components. That is, the heat equation admits a single independent discrete point symmetry, which can be chosen to be alternating the sign of the dependent variable. The developed approach to point-symmetry groups whose elements have components that are linear fractional in some variables is extended to many other linear and nonlinear differential equations. In particular, the Burgers equation admits no discrete point symmetries.

We also briefly discuss point transformations in classes of differential equations in this context, starting from the notion of such classes and various natural structures constituted by point transformations within them. These structures in particular include equivalence groupoids and many kinds of equivalence groups (usual, generalized, extended, extended generalized, effective generalized, effective extended generalized, gauge and insignificant ones). A proper formulation of group classification problems in classes of differential equations is presented as well.