1172-22-4 **Hanna Makaruk*** (hanna_m@lanl.gov), MS H810 P-2 LANL, Los Alamos, NM 87545. *Lie Group Symmetries of Physical Systems.* Preliminary report.

Presence of a Lie group symmetry in a physical system is its powerful, usually underutilized property. In many cases it allows for finding analytical solutions to nonlinear differential equations describing this system. Power of the method is presented on diversified examples from mathematical physics: Lie-group symmetries in finding solutions of generalized, multidimensional theory of gravity; analytical Dirac–equation solutions for description of conducting polymers; stability of qubit states in quantum computers; spatial defects in condensed matter; reconstruction of 3D object from its 2D tomographic image; significant improvement of numerical solutions stability for Euler equations. As much as real symmetries of a physical system should be utilized in finding solutions, imposing a non-existing symmetry on a system results in non-physical solutions. This problem is illustrated on Inverse Abel transform. A Lie group symmetrical solution is by its nature singular; nevertheless, any new analytical solutions of nonlinear differential equations give powerful insights to theoretical physics, and are in high demand for differential equations numerical codes verification. (Received June 23, 2021)