Contribution ID: **29** Type: **Oral**

Systems of Eikonal Equations - Construction of General Solutions.

The eikonal equation is a first-order nonlinear partial differential equation
$u_\mu u_\mu = f(x_\mu, u)$. Such equations are used to describe various physical processes, in particular, ray propagation in optics. We consider equations in the space of independent variables x_μ, where the indices μ span from 0 to some arbitrary n. Here lower indices of functions mean differentiation under x_μ, and we use a standard summation in the Minkovski metric.

Much literature exists on numerical solutions of systems of both coupled and separate eikonal equations. Using hodograph and contact transformations, we construct general exact solutions of such systems as parametric formulae, similar to our results in [1,2]. We also consider the relationship between these general parametric solutions and known exact solutions obtained by the Lie symmetry methods. General solutions of the systems of eikonal equations are useful in the symmetry analysis of partial differential equations, as these systems enter into reduction conditions of many higher-order relativistic PDE.

References
1. Iryna Yehorchenko, General Solution for a Coupled System of Eikonal Equations in Two Space Variables, arXiv:1712.01948
2. Iryna Yehorchenko, Eikonal Equation 0.1,arXiv:2212.09914

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Session Classification: MATHEMATICS

Track Classification: MATHEMATICS