Stationary Calogero–Bogoyavlenskii–Shiff equation and ODEs integrable by quadratures

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We study the relationship between the solutions of stationary integrable partial differential equations and coefficients of the second-order ordinary differential equations invariant with respect to one-parameter Lie group. The classical symmetry method is applied. We prove that if the coefficients (potentials) of ordinary differential equation satisfy the stationary integrable Calogero–Bogoyavlenskii–Shiff equation with two independent variables

$$w_{zxxx} - 2w_z w_{xx} - 4w_{zx} w_x = 0,$$

then the ordinary differential equation is integrable by quadratures [1]. It was shown that the Ermakov equation belong to a class of these equations. In the framework of the approach, we obtained the similar results for generalized Riccati equations. By using operator of invariant differentiation, we describe a class of higher-order ordinary differential equations for which the group-theoretical method enables us to reduce the order of ordinary differential equation.

References

[1] Tsyfra I.M., On classical symmetries of ordinary differential equations related to stationary integrable partial differential equations, *Opuscula Math.* **41** (2021), no. 5, 685–699.