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Soliton surfaces and zero-curvature representation of differential equations

A new version of the Fokas-Gel'fand formula for immersion of 2D surfaces in Lie algebras associated with three forms of matrix Lax pairs for either PDEs or ODEs is proposed. The Gauss-Mainardi-Codazzi equations for the surfaces are infinitesimal deformations of the zero-curvature representation for the differential equations. Such infinitesimal deformations can be constructed from symmetries of the zero-curvature representation considered as PDE in the matrix variables or of the differential equation itself. The theory is applied to zero-curvature representations of the Painleve equations P1, P2 and P3. Certain geometrical aspects of surfaces associated with these Painleve equations are discussed.

Based on joint work with S. Post (University of Hawaii, USA)