Mathematical Physics

Surfaces immersed in Lie algebras associated with elliptic integrals

A. M. Grundland, S. Post

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The main aim of this paper is to study soliton surfaces immersed in Lie algebras associated with ordinary differential equations (ODE's) for elliptic functions. That is, given a linear spectral problem for such an ODE in matrix Lax representation, we search for the most general solution of the wave function which satisfies the linear spectral problem. These solutions allow for the explicit construction of soliton surfaces by the Fokas-Gel'fand formula for immersion, as formulated in (Grundland and Post 2011) which is based on the formalism of generalized vector fields and their prolongation structures. The problem has been reduced to examining three types of symmetries, namely, a conformal symmetry in the spectral parameter (known as the Sym-Tafel formula), gauge transformations of the wave function and generalized symmetries of the associated integrable ODE. The paper contains a detailed explanation of the immersion theory of surfaces in Lie algebras in connection with ODE's as well as an exposition of the main tools used to study their geometric characteristics. Several examples of the Jacobian and P-Weierstrass elliptic functions are included as illustrations of the theoretical results.

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