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Quasi-periodic relativistic strings in the Minkowski space $\mathbb{R}^{1+n}$. (English) [Zbl 1461.35017]

Summary: In this article, we consider the motion of relativistic strings in the Minkowski space $\mathbb{R}^{1+n}$. Those surfaces are known as a timelike minimal surface, and described by a system with $n$ nonlinear wave equations of Born-Infeld type. The one dimensional Born-Infeld equation

$$x_{tt}(1 + x_{\theta}^2) - x_{\theta \theta}(1 - x_t^2) = 2x_t x_{\theta} x_{t\theta}$$

admits an exact time quasi-periodic solution

$$x(t, \theta) = \sin \left( (\omega \cdot l) t + \theta \right) - \sin \left( (\omega \cdot l) t - \theta \right),$$

where $\omega \in \mathbb{R}^n$ denotes the frequencies, and $l \in \mathbb{Z}^n$. By constructing a suitable Nash-Moser iteration scheme, we prove that relativistic strings can admit a more generalized time quasi-periodic motion in $\mathbb{R}^{1+n}$. Moreover, those time quasi-periodic solutions are also timelike solutions.

MSC:
35B15 Almost and pseudo-almost periodic solutions to PDEs
35L71 Second-order semilinear hyperbolic equations
37K55 Perturbations, KAM theory for infinite-dimensional Hamiltonian and Lagrangian systems
83C15 Exact solutions to problems in general relativity and gravitational theory

Keywords:
timelike minimal surface; quasi-periodic solution; Nash-Moser iteration; nonlinear wave equations of Born-Infeld type

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References:


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