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A new technique for the scalar wave equation in curved space-time

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We prove that the equation for the amplitude function for the parametrix of the scalar wave equation can be obtained by covariant differentiation of a first-order non-linear equation.

The construction of such a first-order non-linear equation relies upon a pair of auxiliary 1-forms “psi,rho”.

The 1-form “psi” satisfies the divergenceless condition $\text{div}(\text{psi})=0$, whereas the 1-form “rho” fulfills the non-linear equation $\text{div}(\text{rho})+\langle \text{rho}, \text{rho} \rangle = 0$.

The auxiliary 1-forms “psi,rho” are evaluated explicitly in Kasner space-time, hence, amplitude and phase function in the parametrix are eventually obtained.

Thus, our novel method can be used with profit in physical applications.

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