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*Whitham modulation theory for the Zakharov-Kuznetsov equation and stability analysis of its periodic traveling wave solutions*

We derive the Whitham modulation equations for the Zakharov-Kuznetsov equation via a multiple scales expansion and averaging two conservation laws over one oscillation period of its periodic traveling wave solutions. We then use the Whitham modulation equations to study the transverse stability of the periodic traveling wave solutions. We find that all periodic solutions traveling along the first spatial coordinate are linearly unstable with respect to purely transversal perturbations, and we obtain an explicit expression for the growth rate of perturbations in the long wave limit. We validate these predictions by linearizing the equation around its periodic solutions and solving the resulting eigenvalue problem numerically. We also calculate the growth rate of the solitary waves analytically. The predictions of Whitham modulation theory are in excellent agreement with both of these approaches. Finally, we generalize the stability analysis to periodic waves traveling in arbitrary directions and to perturbations that are not purely transversal, and we determine the resulting domains of stability and instability.