On the wave length of smooth periodic traveling waves of the Camassa-Holm equation

Anna Geyer* and Jordi Villadelprat

1Universitat Autònoma de Barcelona (UAB) – 08193 Bellaterra (Barcelona) SPAIN, Spain

Abstract

This paper is concerned with the wave length \( \lambda \) of smooth periodic traveling wave solutions of the Camassa-Holm equation. The set of these solutions can be parametrized using the wave height \( a \) (or “peak-to-peak amplitude”). Our main result establishes monotonicity properties of the map \( a \mapsto \lambda(a) \), i.e., the wave length as a function of the wave height. We obtain the explicit bifurcation values, in terms of the parameters associated to the equation, which distinguish between the two possible qualitative behaviours of \( \lambda(a) \), namely monotonicity and unimodality. The key point is to relate \( \lambda(a) \) to the period function of a planar differential system with a quadratic-like first integral, and to apply a criterion which bounds the number of critical periods for this type of systems.

*Speaker

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