Nonlocal Solitary Traveling Waves in Diatomic FPUT Lattices under the Equal Mass Limit

Timothy E. Faver[1,*], **Hermen Jan Hupkes**[1]

[1]*Mathematics Institute, Leiden University, The Netherlands*

[*]Email: `t.e.faver@math.leidenuniv.nl`

The diatomic Fermi-Pasta-Ulam-Tsingou (FPUT) lattice is an infinite chain of alternating particles connected by identical nonlinear springs. We prove the existence of nonlocal (or generalized) solitary traveling waves in the diatomic FPUT lattice in the limit as the ratio of the two alternating masses approaches 1, at which point the diatomic lattice reduces to the well-understood monatomic FPUT lattice. These are traveling waves whose profiles asymptote to a small periodic oscillation at infinity, instead of vanishing like the classical solitary wave. Unlike the related long wave and small mass limits for diatomic FPUT traveling waves, this equal mass problem is not singularly perturbed, and so the amplitude of the oscillation is not small beyond all orders. The central challenge of this problem hinges on a hidden solvability condition in the traveling wave equations, which manifests itself in the existence and fine properties of asymptotically sinusoidal solutions to an auxiliary advance-delay differential equation.