Kavitha Louis
Periyar University, Tamil Nadu, India
e-mail: kavithalouis@yahoo.com
A. Marlewski
Pozna University of Technology, Pozna, Poland
A. Muniyappan
Periyar University, Tamil Nadu, India
S. Zdravković
Vinca Institute of Nuclear Sciences, Belgrade, Serbia
D. Gopi
Periyar University, Tamil Nadu, India

Energy localization and shape changing solitons in microtubules

Microtubules are protein polymers made of / tubulin heterodimers that form an essential part of the cytoskeleton of all eukaryotic cells. Besides giving structural stability and rigidity to a cell, microtubules play key roles in many physiological processes such as intracellular vesicle transport and chromosome separation during mitosis. Nucleated MTs (e.g., as nucleated from the centrosome during the mitosis) are tightly attached to the nucleated site by their minus ends and MTs exchange tubulin dimers between the soluble and polymer pools at their free plus ends using the dynamic instability mechanism. Modulational instability (MI) is a universal process in which small phase and amplitude perturbations that are always present in a wide input beam grow exponentially during propagation under the interplay between dispersion and nonlinearity. The mechanism of depolymerization and re-polymerization provides continual supply of energy into the microtubule structures in a cell. As the tubulin heterodimers are polar, the vibrations generate an oscillating electric field that can be excited by the energy released from the hydrolysis of the GTP. Also, we employ the symbolic computation and look for the dynamical equation that supports soliton excitations. It was assumed that the anti-kink formation is mainly due to the hydrolysis of GTP into GDP so that one can act as a hydrolyser which corresponds to the conformational change resulting in the formation of a solitary profile. The propagation will then distribute the energy of hydrolysis at a preferred end of MT. On the other hand, each solitary profile can be viewed as a bit of information whose propagation can be controlled by an external electric field.