NAME: **KENMOGNE Fabien (30 October 2013)**

TITLE : **MODULATED COMPACTONS IN A NEW CLASS OF ELECTRICAL TRANSMISSION LINES AND APPLICATIONS TO GENERATORS**

Abstract

In electronics, the nonlinear transmission line (NLTL) serves as a nonlinear dispersive medium that propagates voltage solitons. Unlike optical solitons, electrical solitons are not suitable for long distance communication because of the high resistive loss present in the NLTL. However, these NLTLs and important applications in signal processing domain. Instead, they are primarily utilized for sharp pulse generation, which is of considerable interest in modern electronics. These pulses can be used to sample rapidly varying signals. They are also used as probe signals for high-precision time-domain reflectometry. In addition, they can be used for impulse radar ranging or in ultra-wideband communication systems. In this thesis, we study a particular class of electrical transmission line with nonlinear dispersion.

That is the basic LC line in which each linear inductor is shunted with a second nonlinear capacitor to create a nonlinear dispersion in the system. We show that the dynamics of modulated signal in this network is governed by the nonlinear Schrodinger type equation (ENLSE) extended by nonlinear dispersion terms. This equation admits a certain number of stable solutions namely the envelope bright and dark solitons, generally supported by the ordinary NLS equation. In addition, with the presence of the nonlinear dispersion, the ENLSE supports also the peaked bright type solitons and the envelope compact dark solitons, and in different frequency domains. There is also the possibility to obtain a

pair of peak-dark, bright-dark and bright-compact dark solitary waves. By means of the ENLSE, the modulational instability (MI) conditions of the slightly modulated signal in this network are found. The results obtained show that the system can exhibit a MI in focusing and defocusing media according to the sign of nonlinear dispersion, in contrast with the system governed by the NLSE where only the focusing media could admit the MI. In the same way, in addition to the fundamental band of MI obtained with the NLSE, this particular unstable system presents also other bands, particularly the higher order and infinite bands. However and in conformity with the NLSE, only the MI criterion of the fundamental band predicts the bright soliton existence. In addition, we show that the peaked soliton existence is predicted by the MI criterion. Our study shows also that the exotic solutions such as peaked and compact dark are predictable starting from the phase portrait, where these two types of signals separate analytical solutions to non-analytical ones. Because of the particular properties of the compact dark signals, a generator of compact dark modulated signals is designed and studied analytically, numerically and by Pspice simulations. This study shows the capacities of this circuit to work as a generator of ultra brief signals, where the use in the radars field can increase in a substantial way their performances. This generator is a basic Colpitts oscillator coupled to the nonlinear transmission line previously studied. Its
performances namely the pulse width and repetition rate are controlled by the parameters characteristic of the Colpitts circuit and the NLTL.

Keywords: Nonlinear electrical transmission line; Gray compacton; Peak soliton; Pulse soliton; Extended nonlinear SchrÄodinger equation; Modulational instability; Modified Colpitts oscillator; Self-sustained envelope compacton generator.