**Abstract for Dynamics Days Crete 2006**
Topic: Applications in Engineering and Nanoscience

# Generation of ultrawideband chaotic radio pulses

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Dynamical chaos is an interesting phenomena that can be applied in different engineering applications. Chaotic signals can be considered as a means to organize multiple access, to improve stability of communication systems in multipath environment, to increase information transmission rate or to encode information and so on. In any case a key element of such systems is chaotic oscillator and control of its oscillation modes is important task. Chaos control is interesting, first of all, because it allows to get a large set of different periodic modes with a single physical device. The task of control is to force a generator to follow a given periodic or chaotic trajectory, with a special attention to the case when this is done by only minor perturbations of the system dynamics. Usually in order to control chaotic oscillations rather complex controlling algorithms are used which can be implemented only with digital hardware. There are no problems to implement them if chaotic oscillator operates in several kHz frequency range but it is rather hard to build controlling hardware if oscillator operates in radio or microwave range.

We consider a purely analogous method permitting as to change fluently oscillation mode of chaotic oscillator as well as to generate a number of practically identical pieces of chaotic trajectory. The discussed approach is outlined in [1, 2] where control of oscillations is realized by means of external force exciting oscillator. According to this method here we theoretically and experimentally consider capability to generate pulses of different forms by changing parameters of exciting force. First chaotic oscillator operating in radio band (several hundreds of MHz) is described and then we consider controlling scheme.

The method allows us to choose initial conditions of phase trajectory and due to chaotic mode of oscillations it yields to possibility of generation of different signals, i.e. we explicitly use the sensitivity of chaotic motion to initial conditions in order to produce signals of different waveform. From the other hand due to the finite divergence rate of phase trajectories it is possible during some period of time to generate practically identical pieces of chaotic trajectory starting from the same initial conditions, i.e. it is possible to obtain pulses with different waveform which are identical in their succession.

During experimental verification we observed identical pulses of 15 ns length with 1/4 duty cycle generated by oscillator operating in 200-600 MHz band and being in chaotic regime.

Applications where the discussed method can be applied in are first of all ultrawideband (UWB) communications and more precisely UWB direct chaotic communication system (DCCS) [3], where information bit-stream is encoded into series of UWB chaotic radio pulses of microwave range emitted in the air. Operation flexibility of DCCS depends on efficiency of generation of chaotic radio-pulses, so this method seems to be rather promising in view of energy efficiency of chaotic pulse generation and for organization of coherent receiver of UWB chaotic signals.

[1] Dmitriev A. et. al., *Technical Physics Letters*, **31**(11), 961-963, (2005).

[2] Dmitriev A. et. al., *Int. J. Bifurcation and Chaos*, (to appear).

[3] Dmitriev A. et. al., *Int. J. Bifurcation and Chaos*, **13**(6), 1495-1507, (2005).