Optical chaos based on a laser diode with positive feedback

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Goals

Globally we would like to transmit a high-frequency signal in encrypted form.

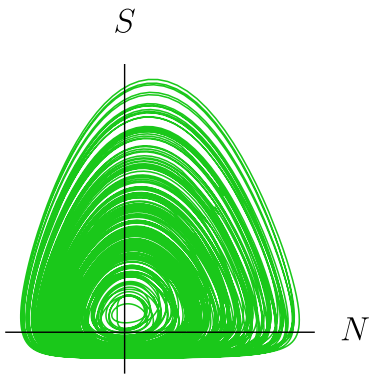
Here, we will consider the following steps towards this goal:

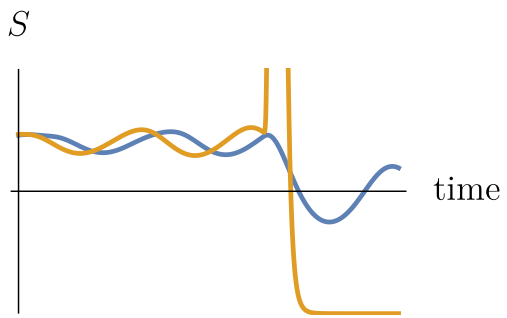
- dynamical chaos and synchronization
  (to encrypt and decrypt signal);
- theory of the laser evolution and its adaptation under our needs;
- realization of the positive feedback in laser:
  theory, modeling and practice.

Definition of dynamic chaos and applications

Map[1] f is **chaotic**, if

- periodic orbits are dense everywhere;
- orbits are mixed;
- f sensitive to the initial conditions.





Possible applications:

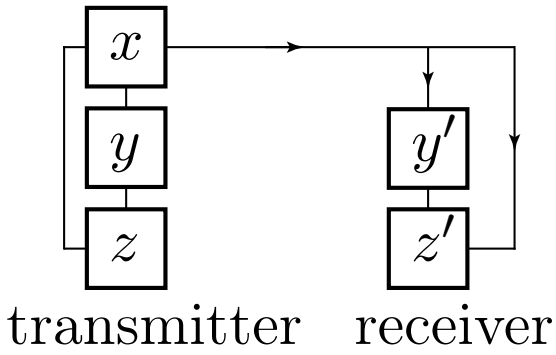
- random numbers generation;
- signal encryption.

[1] W. Hirsch, S. Smale, Introduction to Chaos.

Synchronization

Possible[2] synchronization of chaotic systems:

enough to transmit
part of the signal;
configure system parameters.

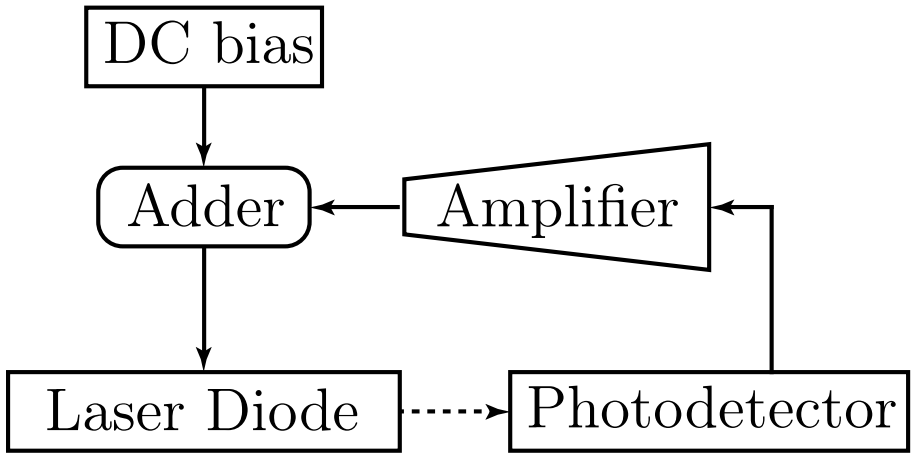


The use of optics to transmit the signal allows to achieve a greater bandwidth of the channel.

UHFO (ultrahight frequency oscillations) is a characteristic to optic systems.

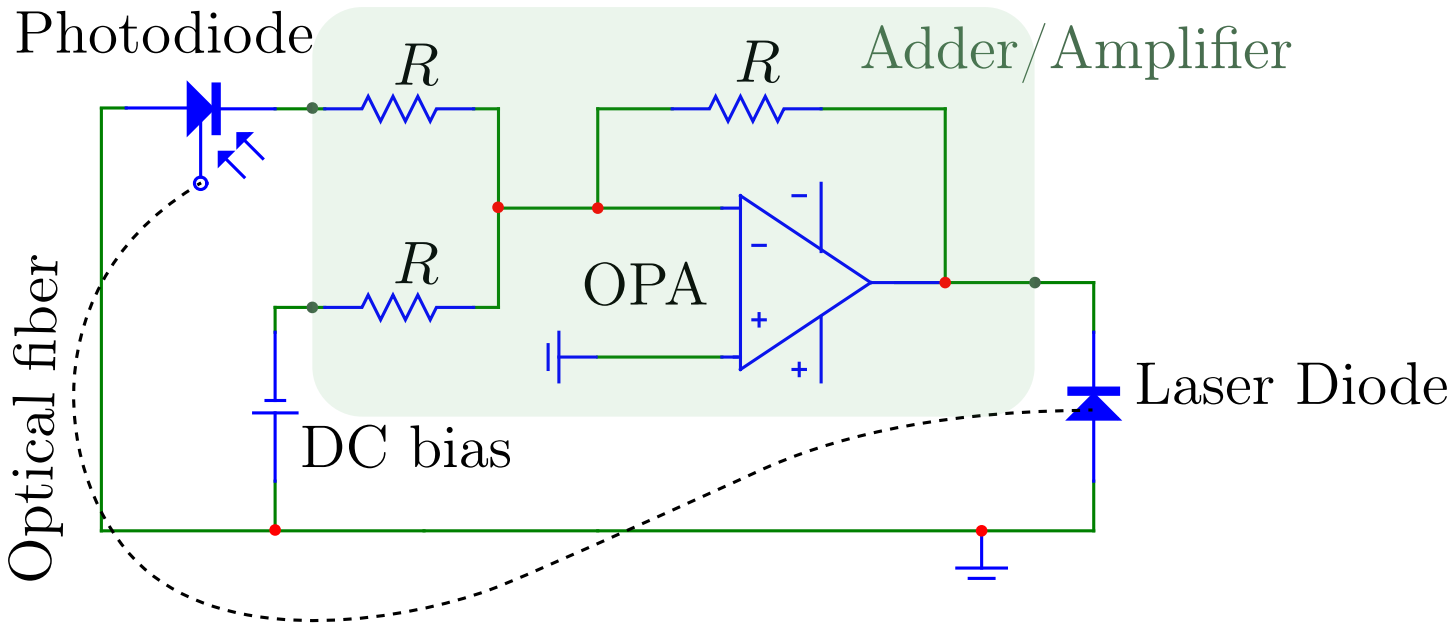
[2] M. Pecora, L. Carroll, Synchronization in Chaotic Systems, 1990.

Concept



Scheme

After several experiments came to this scheme with the summing amplifier:



Photodiode power is enough to not use an additional amplifier.

Realization