Optical chaos based on a laser diode with positive feedback

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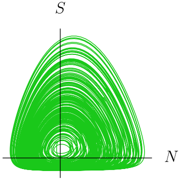
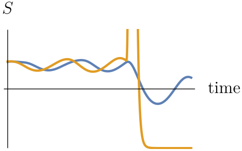
Definition of dynamic chaos and applications

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

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

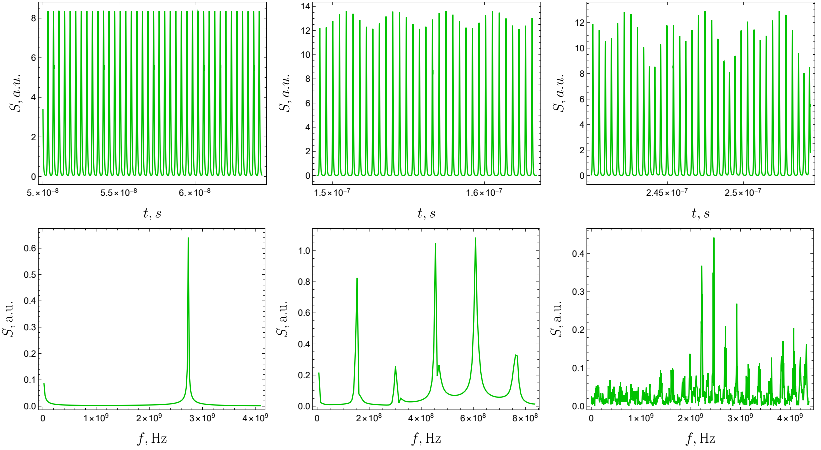




$\Rightarrow$;

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

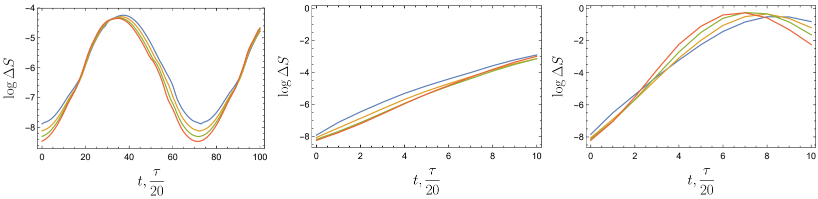
Chaos modelling. Different regimes.



Delay time τ | $2\ T_r$ | $7.5\ T_r$ | $12\ T_r$

Chaos modelling.

Lyapunov exponents calculation :



τ	2 T_r	7.5 T_r	12 T_r
λ	0.0	1.62 f_r	1.84 f_r

$$\Delta S \sim \exp(\lambda t) \;\Rightarrow\; \log \Delta S = \lambda t + \text{const}$$

In real system $S_0^{-1} \int_0^\infty f(\eta) S(t-\eta) d\eta$ instead of $S(t-\tau)$. It reduces oscillations.