Frequency depended chaotic behavior in RLD circuit

P.Gębara[1*], M. Gębara[2]

[1]Department of Physics, Częstochowa University of Technology, 19 Armii Krajowej Av., 42-200 Częstochowa, Poland

[2]Office of European Projects, Jan Długosz University in Częstochowa, Waszyngtona 4/8 Str., 42-200 Czestochowa, Poland

Abstract:

The aim of the present paper was to study chaotic behavior in resistor-inductor diode circuit induced by frequency modulation. Time dependences of voltage and current showed extremely chaotic response of this system. Based on these dependences, the phase space was built. Bifurcation diagram was constructed and based on it, the Feigenbaum's constant was calculated and verified with reliable and noticeable accuracy.

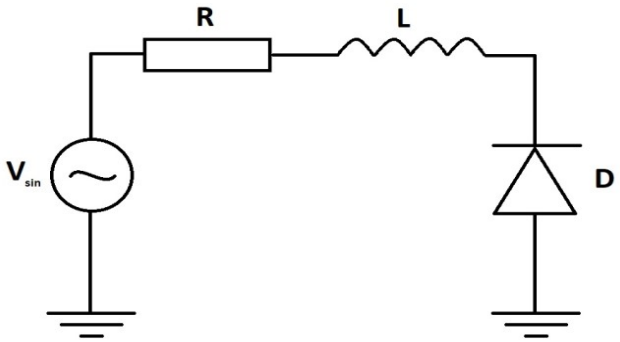

Fig.1. The scheme of the RLD circuit.

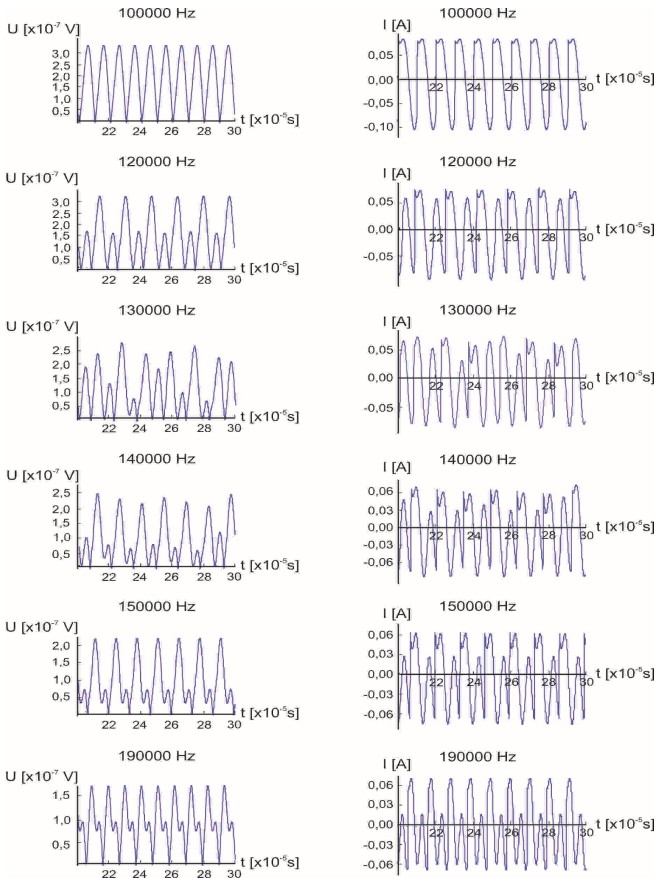

Fig.2. The time dependences of voltage simulated for different values of frequency for analyzed RLD circuit.

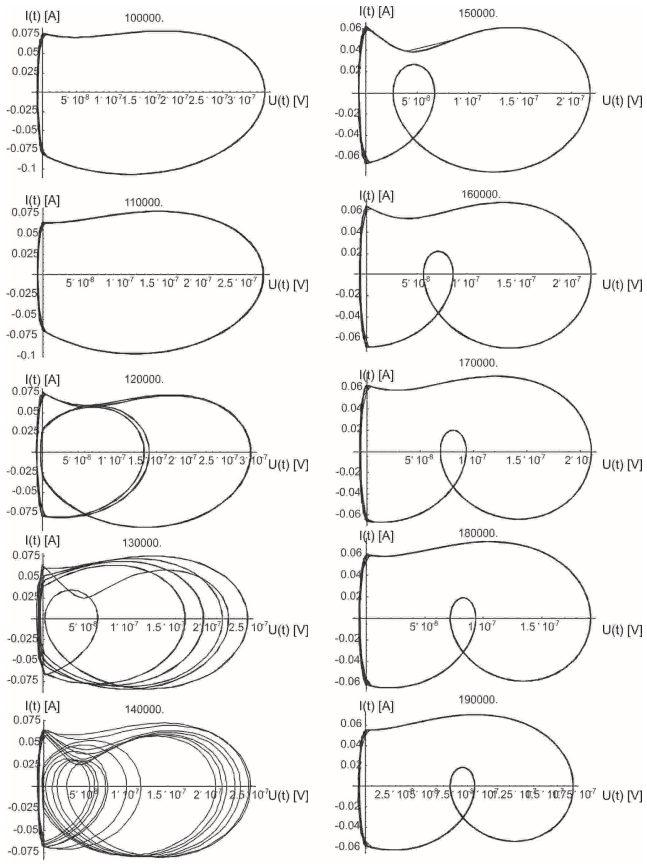

Fig.3. The phase spaces for different values of frequency for analyzed RLD circuit.

Feigenbaum's constant was calculated using following relation:

$$\delta = \frac{f_{n+1} - f_n}{f_{n+2} - f_{n+1}}$$

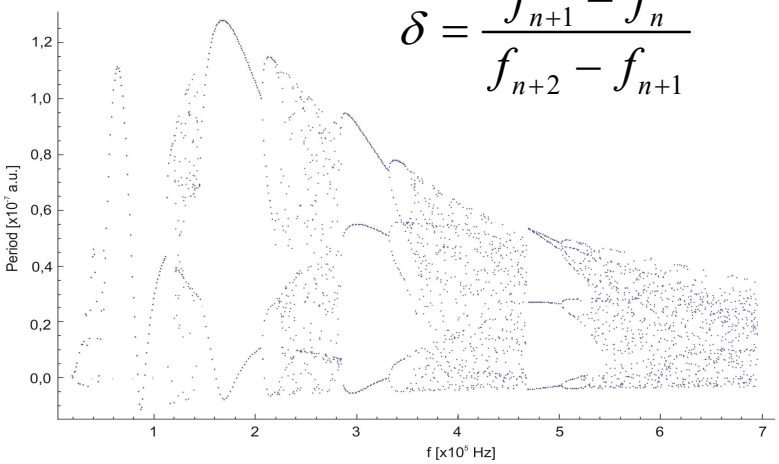

Fig.4. The Feigenbaum's diagram constructed for analyzed RLD circuit.

Conclusions

In the present paper, the chaotic behavior of the resistor-inductor-diode series circuit was simulated. It was shown that such simple system is very sensitive on frequency changes. Chaotic behavior was presented using time dependences of voltage or current. Moreover, it was proven by construction of phase space for different values of frequency. Further analysis, including plotting of Feigenbaum's diagram, confirmed multiplying of period with an increase of frequency. This diagram allowed to calculate parameter δ (Feigenbaum's constant) and it equaled 4.23±0.12. Such value corresponds well with theoretical predictions.