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PROPAGATION OF SOLITONS IN SURFACE STRUCTURES

Todorka Chervenkova[1], Atanas Chervenkov[2]

Technical University of Sofia, 8, Kliment Ohridski blvd., 1000 Sofia, Bulgaria
E-mail: tchervenkova@tu-sofia.bg [1], acher@tu-sofia.bg [2]

ABSTRACT

The non-linear circuit, which generates solitons, is obtained. The specific circuit scheme with electronic device- variable capacitance diode, which helps generate solitons, has been chosen. The distribution of solitons along the linear surfaces is investigated. The model of investigation surface, where the solitons are propagated, is represented. It is considered as a linear circuit with distributed parameters with active losses. Surfaces with different area size are investigated. The greatest reduction is in the first cells of the surface area. The reduction of the soliton amplitudes along y-axis remain of less in the direction of x-axis. The surface area affects of the generation of solitons in the non-linear circuit.

Index Terms - Soliton, generation, propagation, non-linear circuit, distribution parameters, variable capacitance diode.

1. INTRODUCTION

The propagation of solitons (solitary waves) in surfaces is investigated.

The solitons are generated in the non-linear circuit. It is presented as non-linear circuit with distribution parameters, which include non-linear capacitors [1].

The non-linear circuit consists of multiple sections (cells), which included inductance, capacitor and non-linear capacitor, presented by variable capacitance diode.

The investigation surface is connected in the end on non-linear circuit as load.

2. DESCRIPTION OF THE INVESTIGATION CIRCUIT

The non-linear circuit, which generate soliton, is represented in Fig.1.

The sinusoidal generator in the input of non-linear circuit is connected.

In the end on non-linear circuit investigation surface load Z_T is connected.

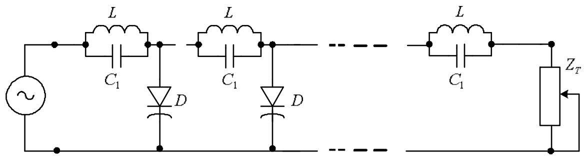

Figure 1 Non-linear circuit

In this case the load is surface, which is presented as linear circuit with distribution parameters also.

The non-linear circuit contains n number LC_1D cells.

Non-linearity of the circuit is determined by the dependence of the capacity of voltage of variable capacitance diode D.

The input of non-linear circuit is a generator of sinusoidal signals. The amplitude of generator is 10V.

Linear inductance L is $23\ \mu H$ and linear capacity - $10\ pF$.

Not-linear circuit is studied under several parameters of non-linear diodes (variable capacitance diodes). The Conditions under which not-linear circuit creates solitons are explored. Variable capacitance diode BB439 is used, which give appropriate solitons.

3. PREVIOUS INVESTIGATIONS

In [2, 3, and 4] are described cases of presentation of the load of non-linear circuit. In [2] propagation of the solitons along length of linear circuit is investigated and presented by RC cells and in [3] the linear circuit is presented by RL cells. The common case – presentation of the linear circuits with distribution RLC cells are described in [4]. Here it is considered as a circuit with distributed parameters with active, inductive and capacitance losses.

In all of existing research the spread of soliton waves along only one direction of linear transmission line has investigated.

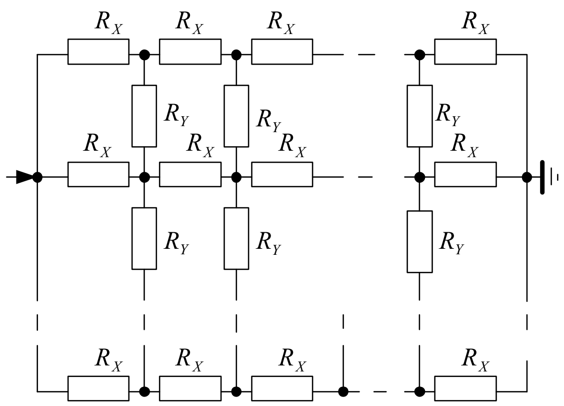

Figure 2 Model of the surface load

4. SURFACES MODEL OF LOAD

The interest presents the event, when solitons are propagated on surfaces.

Exactly, this can be surfaces of biological body, particular surfaces of human body and surfaces of electronic devices.

The model of investigation surface, where the solitons are propagated, is represented in Figure 2.

It consists only of resistor i.e. this is representation of surface with active losses.

Initially the surface of 5 cells is examined. The next stage is to examine the load surface, represented by 8 and 10 cells.

Each cell represents 1 square meters of research surface.

5. DISTRIBUTION OF THE SOLITONS ON SURFACE

A computer simulation of non-linear circuit is made. The time solitons are obtained.

The results of computer simulation in the time domain is represented in figure 3.

The several solitons are received and they form "solitons package".

The solitons are generated in the end of non-linear circuit.

Amplitude of the largest soliton exceeds several times the amplitude of the sinusoidal source.

The amplitude of largest soliton (in the end on non-linear circuit) is approximately 29 V (see curve 1 in fig. 3).

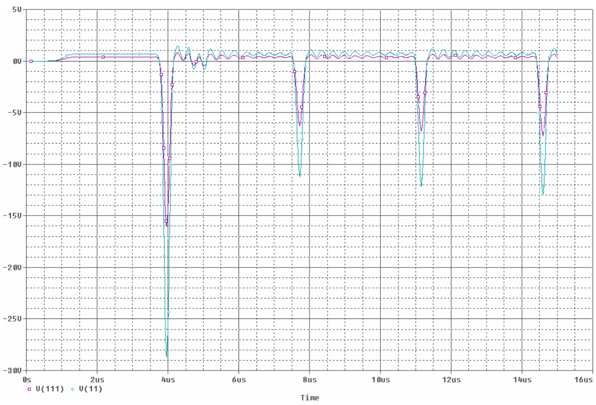

Figure 3 Generation of solitons in non-linear circuit

Distribution of solitons on surface in time is obtained.

The propagation of solitons along the x- and y-axes of surfaces at fixed time is investigated.

In the first stage the surfaces with different area size are investigated. The surface area is 5 m^2.

The distribution of soliton amplitudes with the highest amplitude along the x-axis of linear surface load in the cases of presentation with 5 resistors is shown in Figure 4.

The amplitude of largest soliton (in the end of x-axis of surface load) is 16 V (see curve 1 in fig. 4).

The distribution of soliton amplitudes with the highest amplitude along the y-axis of linear surface load in the cases of presentation with 5 resistors is shown in Figure 5.

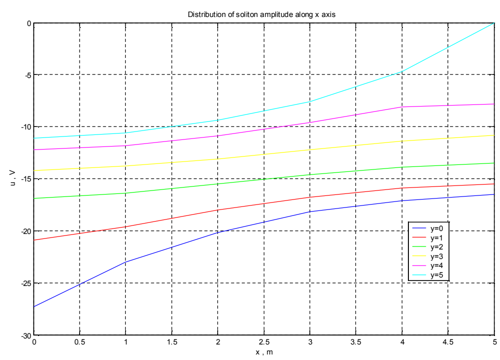

Figure 4 Distribution of the solitons along the x-axis of surface 5x5 m

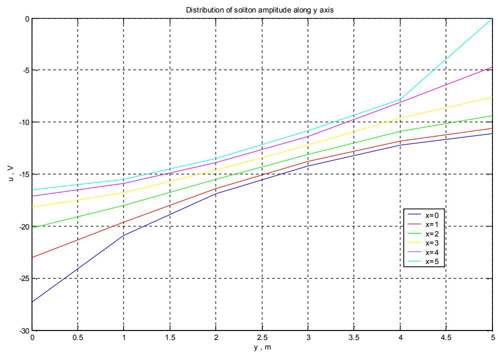

Figure 5 Distribution of the solitons along the y-axis of surface 5x5 m

The distribution of soliton amplitudes with the highest amplitude on the surface in the cases of presentation with 5x5 cells of resistors is shown in Fig. 6.

The reduction of the soliton amplitudes of less remain in the direction of x-axis. This probably is due to anisotropy of circuit on y-axis.

In the next stage the surfaces with different area size are investigated. The surface area is 8 m^2.

The distribution of soliton amplitudes with the highest amplitude along the x-axis of linear surface load in the cases of presentation with 8 resistors is shown in Figure 7.

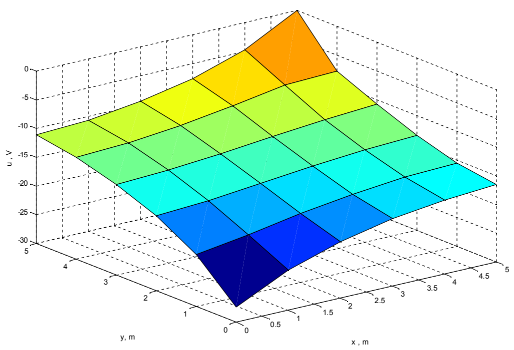

Figure 6 Distribution of the solitons on surface area 5x5m

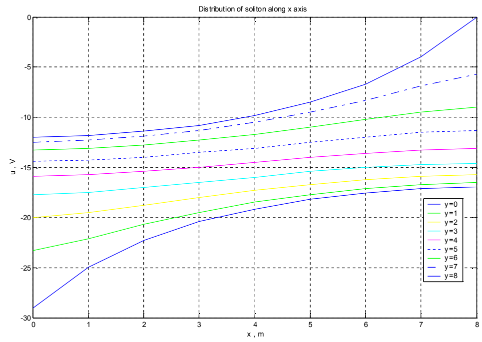

Figure 7 Distribution of the solitons along the x-axis of surface 8x8 m

The distribution of soliton amplitudes with the highest amplitude along the y-axis of linear surface load in the cases of presentation with 8 resistors is shown in Figure 8.

The reduction of the soliton amplitudes of less remain in the direction of x-axis also.

The distribution of soliton amplitudes with the highest amplitude on the surface in the cases of presentation with 8x8 cells of resistors is shown in Figure 9.

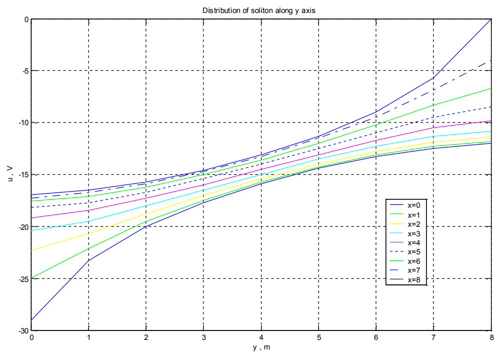

Figure 8 Distribution of the solitons along the y-axis of surface 8x8 m

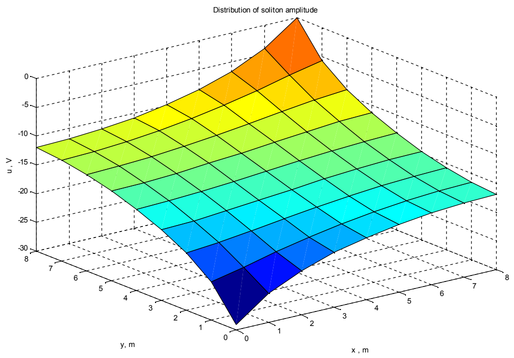

Figure 9 Distribution of the solitons on surface area 8x8m

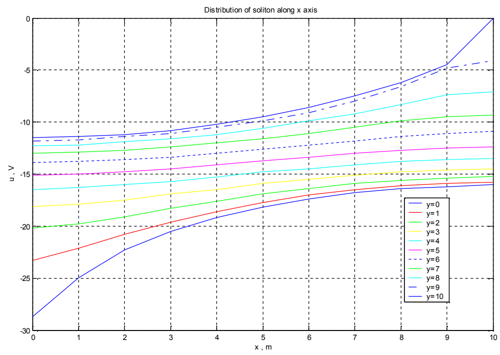

Figure 11 Distribution of the solitons along the y-axis of surface 10x10 m

The reduction of the soliton amplitudes is significantly in a relatively large length of the surface area.

In the last stage the surfaces with different area size are investigated. The surface area is 10 m^2.

The distribution of soliton amplitudes with the highest amplitude along the x-axis of linear surface load in the cases of presentation with 10 resistors is shown in Figure 10.

The greatest reduction is in the first nodes of the linear distributed load.

The distribution of soliton amplitudes with the highest amplitude along the y-axis of linear surface load in the cases of presentation with 10 resistors is shown in Figure 11.

In the case of large size of area, the reduction of the soliton amplitudes along y-axis remains too less toward of reduction in the direction of x-axis.

The distribution of soliton amplitudes with the highest amplitude along the x-axis of linear surface in the cases of presentation with 10 resistors is shown in Figure 12.

A comparison of the representation of the surface by 3 different lengths is made. The results of distribution of soliton along x-axis by fixing coordinate y = 4m are shown in figure 13.

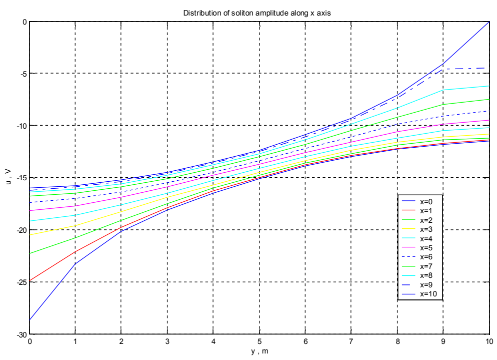

Figure 10 Distribution of the solitons along the x-axis of surface 10x10 m

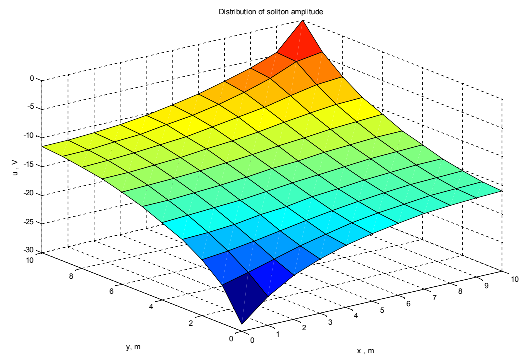

Figure 12 Distribution of the solitons on surface area 10x10 m

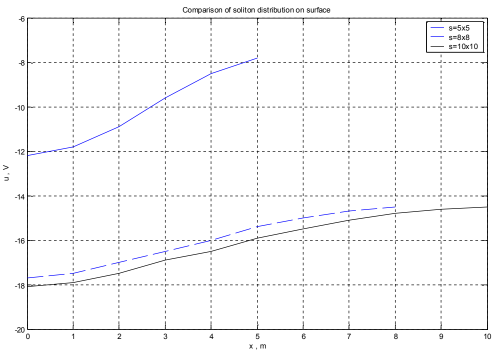

Figure 12 Comparison of surface presentation

The results indicate, that surface presentation of the case of relatively large lengths not exceeding 1.5%.

6. CONCLUSION

The non-linear circuit, which generates solitons, is obtained.

The model of investigation surface, where the solitons are propagated, is represented.

The distribution of solitons along the linear surfaces is investigated. It is considered as a linear circuit with distributed parameters with active losses.

The reduction of the soliton amplitudes is significantly in a relatively large length of the surface load.

The greatest reduction is in the first cells of the linear distributed surfaces.

The reduction of the soliton amplitudes along y-axis remain of less in the direction of x-axis.

The surface load affects of the generation of solitons in the non-linear circuit.

7. REFERENCES

[1] Grigirov G., A. Chervenkov, V. Mladenov, T. Chervenkova, S. Papazov, “Generation of solitons in non-linear transmission line”, Proceedings of the Technical University of Sofia, vol. 56, 2006, pp. 344-350.

[2] Atanas Chervenkov and Todorka Chervenkova, “Propagation of soliton in linear structures”, 51 Internationales Wisesnschaftlishes Kolloquium Technishe Universität Ilmenau Germany, 11-15 September 2006.

[3] Todorka Chervenkova, “Propagation of solitons in transmission line with losses”, Proceedings of the Technical University of Sofia, vol. 57, book 1, 2007, pp. 33-40.

[4] Todorka V. Chervenkova, Atanas G. Chervenkov, “Propagation of solitons in transmission line”, Proceedings of the Technical University of Sofia, vol. 58, book 1, 2008, pp.152-159.