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ПО МАТЕРИАЛАМ МЕЖДУНАРОДНОЙ НАУЧНО-ТЕХНИЧЕСКОЙ КОНФЕРЕНЦИИ СТУДЕНТОВ, АСПИРАНТОВ И МОЛОДЫХ УЧЕНЫХ

«НАУЧНАЯ СЕССИЯ ТУСУР–2020»

г. Томск, 13–30 мая 2020 г.

(в двух частях)

ЧАСТЬ 2

г. Томск

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Сборник избранных статей научной сессии ТУСУР включает избранные доклады по итогам Международной научно-технической конференции студентов, аспирантов и молодых ученых. Конференция посвящена различным аспектам разработки, исследования и практического применения радиотехнических, телевизионных и телекоммуникационных систем и устройств, сетей электро- и радиосвязи, вопросам проектирования и технологии радиоэлектронных средств, аудиовизуальной техники, бытовой радиоэлектронной аппаратуры, а также автоматизированых систем управления и проектирования. Рассматриваются проблемы электроники СВЧ- и акустооптоэлектроники, нанофотоники, физической, плазменной, квантовой, промышленной электроники, радиотехники, информационно-измерительных приборов и устройств, распределенных информационных технологий, вычислительного интеллекта, автоматизации технологических процессов, в частности, в системах управления и проектирования, информационной безопасности и защиты информации. Представлены статьи по математическому моделированию в технике, экономике и менеджменте, антикризисному управлению, правовым проблемам современной России, автоматизации управления в технике и образовании, а также работы, касающиеся социокультурных проблем современности, экологии, мониторинга окружающей среды и безопасности жизнедеятельности.

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POSTGRADUATE AND MASTER STUDENTS' RESEARCH IN ELECTRONICS AND CONTROL SYSTEMS

(Секция на английском языке)

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Thus, in the structure of a reflection symmetric ML, in which all the conductors are connected at one end, it is possible to decompose the excitation USP into a sequence of pulses with a maximum amplitude less than the EMF amplitude. In addition, such a connection will dispense with the resistors at the far end of the line, which increases reliability and reduces costs.

The reported study was funded by Russian Science Foundation (project №19-19-00424).

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THE EFFECT OF THE DIMENSION DOMAINS ON THE CURRENT DISTRIBUTION ALONG TWO COUPLED WIRES OVER A GROUND PLANE

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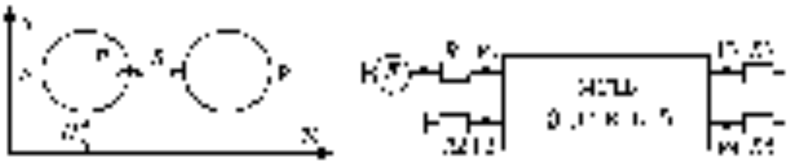
An algorithm for estimating the radiated emission from modal-reservation circuits was proposed, which shows an acceptable match in the current distribution and the radiation pattern of the two-wire test structure. This paper is aimed at testing this algorithm in two different dimensions. The results proved the possibility of using this algorithm in different dimensional domains, as long as they satisfy the limits of quasi-static analysis.

Keywords: modal-reservation, radiation pattern, quasi-static.

The levels of radiated emission from circuits with modal reservations are important to solve the problem of electromagnetic compatibility [1]. Using the advantage of combining the quasi-static and the electrodynamic analyses can give more accurate results. In order to study this approach and discuss its efficiency, we are studying different structures under different situations and conditions.

We considered a case of two coupled wires above an infinite ground (see Fig. 1a), assuming a short circuit at the input and an open circuit at the output, with a length (L) of 0.3 m and a number of segments (n) of 35 for each wire. Considering that, the surrounding area is an open air space and the wires are lossless to simplify the test. The initial data for designing the circuit diagram are the following: $R1 = 10^{-8}$ Ohm, $R2 = R3 = R4 = 10^6$ Ohm and a harmonic source E=1 V as excitation at the input connected to the active conductor (see Fig. 1, *b*). The distance at which we calculated the electric field intensity in the far zone is about 1.8 m.

The equivalent circuit was modeled using the electrodynamic analysis by replacing the infinite ground with two mirror wires with the same length. The harmonic source was replaced with E = 2 V excitation between the active conductor and its mirror.



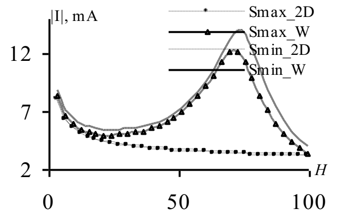
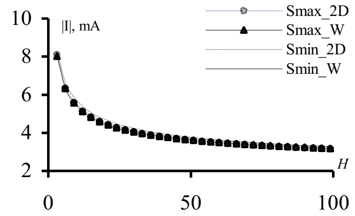
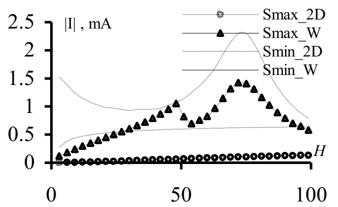
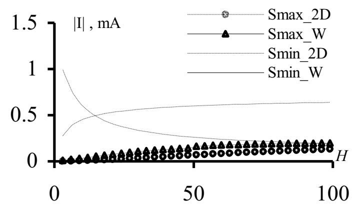
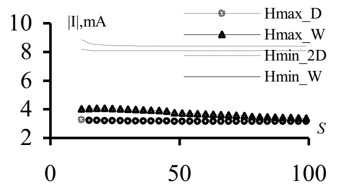
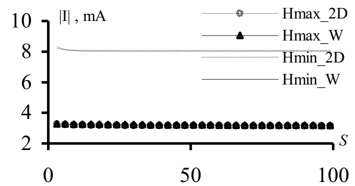
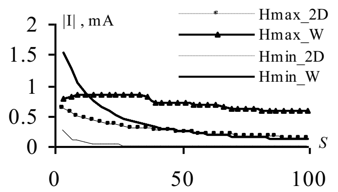
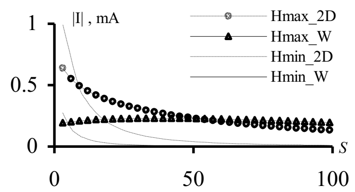
a *b*

Fig. 1. The cross section (*a*) and circuit diagram (*b*) of the tested structure

We performed the simulation in the TALGAT [2] software at the frequency of 500 MHz. The results are compared for two dimensional conditions of a millimeter and a micrometer separately. We changed the distance that separates the wires (S) and the distance from the ground where the wires are placed at (H) in the range from 3 to 99 mm/µm and the radius (R) of 1 mm/µm. We calculated the maximum values of current distribution along the passive and active wires by changing H or S (Table), considering that S or H is at its minimum and maximum values.

The current distributions along the wires with the strongest possible coupling between the wires are shown in Fig 2. The maximum absolute values of the total field obtained by using the algorithm (2D) and by field calculation (W) are 23.3 and 20.5 mV/m, respectively, for millimeter dimensions, and lower by factor 1000 for micrometer dimensions.

Maximum values of current distribution by changing *H* and *S*

	Millimeter	Micrometer
Active		
Active mirror		
Passive		
Passive mirror		

The implemented algorithm gave close enough results with dimensions of micrometers. However, the results remain acceptable unless they exceed the limits of quasi-static analysis, which states that the dimensions of the considered structure must be much smaller than the wavelength. As shown in Table, the maximum values of the obtained current from the electrodynamic analysis rises up by factor 7 in the active wire by changing H with dimensions of millimeters and gets the peak value at a distance of 72 mm, i.e. the distance between the wire and its mirror is about 150 mm, which corresponds to a quarter of the wavelength. The resonance also occurs in the mirror of the active wire where the values of the maximum currents become smaller; here we can also notice the same situation with the active wire but we found that another peak shows up at a distance of 48 mm, which means that the distance between the wire and its mirror is one sixth of the wavelength.

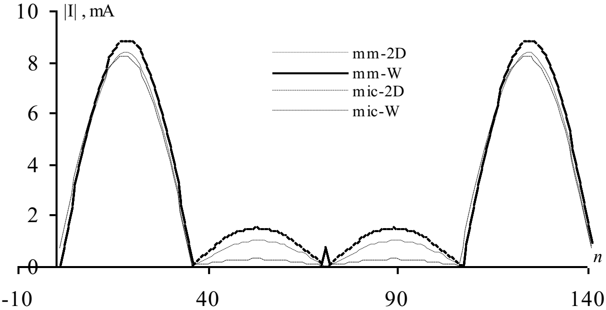


Fig. 2 The current distributions along the wires

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A MODAL FILTER WITH A PARALLEL OSCILLATORY CIRCUIT IN A PASSIVE CONDUCTOR

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The paper presents the analysis of the frequency response of a two-wire modal filter (MF) with a parallel oscillating circuit in a passive conductor and shows that resonators allow increasing insertion losses in the attenuation band. The results were obtained for the electrodynamic simula-