EXPERIMENTAL AND THEORETICAL STUDY OF THE SUPERCONDUCTING SIGMA NEURON

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A superconducting sigma neuron is a single-junction interferometer, part of the circuit of which is shunted by an additional inductance. It is designed to nonlinearly transform the input signal (magnetic flux) in accordance with a certain sigmoidal law. Such an interferometer should be implemented as a multilayer thin-film structure over a superconducting screen to ensure independence of setting and reading the magnetic flux in the neuron elements. An experimental implementation of such a device, as well as an experimental measurement of its transfer function, were presented in [1]. The main results of the theoretical model [2] were confirmed, but the possibility of interaction of the neuron elements through the superconducting screen was revealed which wasn't taken into account earlier. In the report a generalized method for analyzing the transfer function of a sigma neuron will be presented, which allows taking into account all components of the inductance matrix. The obtained formulas allow achieving good agreement between the experimental and numerical curves when using the calculated inductance matrix obtained by means of the 3DMLSI program [3]. The developed approach will allow designing next-generation sigma neurons with a predetermined form of the transfer function.

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References

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