DC SQUID(Superconducting Quantum Interference Device) is an electronic circuit, which consists two parallel Josephson junctions in a superconductive loop. [1] Two important phenomena characterize DC SQUID’s physical behaviors, one of them is Josephson tunnelling and another is magnetic flux quantization. Josephson junctions induce Josephson tunneling, and superconductive loop cause quantization of magnetic flux inside the loop. Inside the superconductive loop, magnetic flux is integer multiplier of magnetic flux quanta . ()[1], [2] There is a relation between applied external magnetic field and critical current of the DC SQUID. According to the relation, average voltage across to the DC SQUID is related with /. ( is magnetic flux due to external magnetic field.) Due to the value of magnetic flux quanta (), sensitive magnetic fields measurement can be done by using DC SQUIDs. [1], [2] Today DC SQUIDs are extensively used in commercially applications. (Microscopy, readout electronics, nondestructive test, biomagnetism applications…)[2], [3] DC SQUID’s voltage response against external applied magnetic field is limitedly linear, this situation may cause difficulties in applications. As a result of difficulties, researchers tend to investigate SQUID based circuits, which is more linear than conventional DC SQUIDs (Bi-SQUID, arrays of SQUIDs, …, etc.). Bi-SQUID is one of the alternative solutions instead of the conventional DC SQUID, Bi-SQUID is designed by adding a parallel Josephson junction to typical DC SQUID. Bi-SQUID ‘s voltage response against external applied magnetic field is more linear than DC SQUID. [4] Magnetic field response of Bi-SQUID characterized by set of differential equations, there is no easy analytic way to solve these equations. [4], [5] Numerical simulations play critical role for this type of systems, modelling and simulation methods can support design studies. In this work, we designed open source and user-friendly simulation tool. In addition, we did statistical analysis study for Bi-SQUID by using simulation tool.

[1] A. Barone ve G. Paternò, *Physics and applications of the Josephson effect*. New York: Wiley, 1982.

[2] J. Clarke, “Squid Fundamentals”, içinde *SQUID Sensors: Fundamentals, Fabrication and Applications*, H. Weinstock, Ed. Dordrecht: Springer Netherlands, 1996, ss. 1-62. doi: 10.1007/978-94-011-5674-5\_1.

[3] R. L. Fagaly, “Superconducting quantum interference device instruments and applications”, *Review of Scientific Instruments*, c. 77, sy 10, s. 101101, Eki. 2006, doi: 10.1063/1.2354545.

[4] V. K. Kornev, I. I. Soloviev, N. V. Klenov, ve O. A. Mukhanov, “Bi-SQUID: a novel linearization method for dc SQUID voltage response”, *Supercond. Sci. Technol.*, c. 22, sy 11, s. 114011, Eki. 2009, doi: 10.1088/0953-2048/22/11/114011.

[5] P. Longhini *vd.*, “Voltage Response of Non-Uniform Arrays of Bi-SQUIDs”, içinde *International Conference on Theory and Application in Nonlinear Dynamics (ICAND 2012)*, V. In, A. Palacios, ve P. Longhini, Ed. Cham: Springer International Publishing, 2014, ss. 77-90. doi: 10.1007/978-3-319-02925-2\_7.

Due to the value of magnetic flux quanta (), sensitive magnetic fields measurement can be done by using DC SQUIDs. Today, DC SQUIDs are extensively used in commercially applications as magnetometers. (Microscopy, readout electronics, nondestructive test, biomagnetism applications…) [1] DC SQUID’s voltage response against external applied magnetic field is limitedly linear, this situation may cause difficulties in applications. As a result of difficulties, researchers tend to investigate DC SQUID based circuits, which is more linear than conventional DC SQUIDs (Bi-SQUID, arrays of SQUIDs, …, etc.). Bi-SQUID is one of the alternative solutions instead of the conventional DC SQUID, Bi-SQUID is designed by adding a parallel Josephson junction to typical DC SQUID. Bi-SQUID ‘s voltage response against external applied magnetic field is more linear than DC SQUID. [2]

External applied magnetic field response of Bi-SQUID characterized by set of differential equations, there is no easy analytic way to solve these equations. [2], [3] Therefore, numerical analysis plays critical role for this type of systems. Modelling and simulation tools can support design studies by using numerical methods. However, there is no sustainable and accessible modelling and simulation application exist for Bi-SQUIDs nowadays.

We developed an open-source and user-friendly statistical analysis tool for symmetric Bi-SQUIDs. Our developed simulation tool solves systems of differential equations, which are represent Bi-SQUID system, in defined resolution (time step, external magnetic field sampling resolution) by user. Our methodology is based on finding voltage response of a symmetric Bi-SQUID for each time steps in period. Our tool gives average voltage response of symmetric Bi-SQUID for each corresponding normalized applied external magnetic flux () as an output. Normalized external magnetic flux range can be determined by the user. Moreover, our simulation tool provides multiple-runs for statistical analysis of Bi-SQUID. User can determine margin and data-range for one of the input parameters, and tool generates random numbers in defined margin and data-range for determined parameter. After that, simulation generates output (voltage response in external applied magnetic field) for each random situation in defined margin. These output sets, provide wide range of design options to user in defined margin and data-range. Users can easily observe reliable working-range of Bi-SQUID circuit in defined margin and user can optimize Bi-SQUID design problems by using output dataset.

We developed an open-source and user-friendly statistical analysis tool for symmetric Bi-SQUIDs. Our simulation tool solves systems of differential equations, which are represented Bi-SQUID system, in defined resolution (time step, external magnetic data-range) by the user. Our methodology is based on finding the voltage response of the symmetric Bi-SQUID for each time steps in the period. Our tool gives the average voltage response of symmetric Bi-SQUID for each corresponding normalized applied external magnetic flux () as an output. The normalized applied external magnetic flux range can be determined by the user. Moreover, our simulation tool provides multiple runs for the statistical analysis of Bi-SQUID. Users can determine margin and data range for one of the input parameters, and the tool generates random numbers in defined margin and data range for the determined parameter. After that, the simulation tool generates output (voltage response in an external applied magnetic field) for each random situation in a defined margin. These output sets, provide a wide range of design options to the user in defined margin and data range. Users can easily observe a reliable working range of Bi-SQUID circuits in defined margin and users can optimize Bi-SQUID design problems by using output dataset.

Bu çalışma kapsamında, simetrik Bi-SQUID için kullanıcı dostu açık kaynak kodlu analiz ve simülasyon aracı geliştirilerek, sistemin istatistiksel analizi yapılmıştır. Geliştirmiş olduğumuz simülasyon aracı, kullanıcı tarafından belirlenen çözünürlükte(time step, external magnetic field sampling resolution) simetrik Bi-SQUID için sistemi temsil eden diferansiyel denklem setini bir periyot boyunca çözerek, sistemin manyetik alan tepkisini kullanıcıya çıktı olarak vermektedir. Programın çıktısı, normalize dış manyetik akıya karşı Bi-SQUID sisteminin gerilim tepkisidir. MAnyetik alan tepkisi, kullanıcı tarafından belirlenen aralık boyunca elde edilmektedir. Ayrıca simülasyon kullanıcının çoklu koşular yapmasına olanak sağlamaktadır. Kullanıcı tarafından belirlenen herhangi bir input parametresi, kullanıcı tarafından belirlenen margin boyunca rassal olarak üretilmektedir. Sonrasında oluşturulan her bir rastgele very seti boyunca simülasyon çalışarak, her bir durum için çıktı üretmektedir. Bu sonuç kullanıcıya belirli marginler çerçevesinde Bi-SQUID davranışını vermektedir. Kullanıcı bu sonuçtan faydalanarak tasarımını poptimize edebilir ve B-SQUID devrenin sağlıklı çalıştıuğı durumları göreilir.

[1] R. L. Fagaly, “Superconducting quantum interference device instruments and applications”, *Review of Scientific Instruments*, c. 77, sy 10, s. 101101, Eki. 2006, doi: 10.1063/1.2354545.

[2] V. K. Kornev, I. I. Soloviev, N. V. Klenov, ve O. A. Mukhanov, “Bi-SQUID: a novel linearization method for dc SQUID voltage response”, *Supercond. Sci. Technol.*, c. 22, sy 11, s. 114011, Eki. 2009, doi: 10.1088/0953-2048/22/11/114011.

[3] P. Longhini *vd.*, “Voltage Response of Non-Uniform Arrays of Bi-SQUIDs”, içinde *International Conference on Theory and Application in Nonlinear Dynamics (ICAND 2012)*, V. In, A. Palacios, ve P. Longhini, Ed. Cham: Springer International Publishing, 2014, ss. 77-90. doi: 10.1007/978-3-319-02925-2\_7.