SuperMix Now Available

F. Rice, J. Ward, J. Zmuidzinas, and G. Chattopadhyay

California Institute of Technology, 320-47, Pasadena, CA 91125, USA.

SuperMix, an extensive C++ software library written to aid in the design and optimization of high-frequency circuits, is now available for free download at ***www.submm.caltech.edu/supermix***. Over the past year SuperMix has been used to develop a terahertz quasioptical SIS receiver design and to optimize the design of a low noise 4-8 GHz HEMT IF amplifier. SuperMix is briefly described in [1].

Containing over 30,000 lines of extensively-documented source code, the SuperMix class library is flexible and complete, allowing users to quickly write, compile, and run sophisticated circuit simulations of arbitrary complexity. By representing circuit components as C++ class objects, the library provides for natural, nearly self-documenting code which reads more like a circuit description than a program. Although primarily intended for superconducting submillimeter circuit design, SuperMix provides a complete set of circuit elements suitable for frequency-domain simulations from DC to the terahertz range. Its lumped elements include detailed HEMT transistor models as well as passive components. Its high frequency distributed elements include standard components such as transmission lines, hybrids, attenuators, etc. What sets SuperMix apart, however, is its inclusion of SIS quasiparticle tunnel junctions and physical transmission line components such as microstrip and CPW lines. The physical transmission line objects can be built up from layers of normal metal and superconducting films and real dielectrics. These components are specified by their material characteristics and dimensions which SuperMix uses to determine electrical behavior.

SuperMix can perform full harmonic balance calculations of SIS quasiparticle receiver designs of arbitrary complexity as well as mixer gain and noise analyses using any number of harmonics and including any number of superconducting tunnel junctions. Its algorithms and capabilities in this regard are described in [2].

SuperMix performs circuit calculations using a wave matrix representation and automatically includes full noise calculations. It can freely convert results between wave and impedance or admittance representations. Supermix includes a sophisticated multiparameter optimizer. Users can quickly tailor the optimizer's error function to their exact needs; the optimizer can then control any set of device parameters in order to refine a circuit design. To achieve this level of flexibility, SuperMix contains a rather complete numerical math library for manipulation of complex-valued matrix, vector, and scalar functions and objects. It includes robust linear algebra, interpolation, integration, root finding, and minimization routines.

SuperMix includes a large set of formatted input and output routines for complex-valued matrix and vector data. SuperMix can construct interpolated circuit elements from Touchstone formatted data. If the provided routines are inadequate for a specific application, the user can easily add to the input/output capabilities using an extensive set of primitives. Of course, since the user creates simulations by writing a C++ program, the full capabilities of the standard C++ class libraries are available as well.

SuperMix is designed to run under Unix or Linux. It currently requires the free g++ (or gcc) compiler, available on most systems. It has been thoroughly tested on Solaris and Intel Linux platforms. Information regarding the system requirements and how to install and use the library are provided in the README files accompanying the library distribution file.

References

[1] J. Ward, F. Rice, G. Chattopadhyay, and J. Zmuidzinas, "SuperMix: a flexible software library for high-frequency circuit simulation, including SIS mixers and superconducting elements," *Proc. Tenth International Symposium on Space Terahertz Tech.*, pp. 269–281, 1999.

[2] F. Rice, J. Ward, J. Zmuidzinas, and G. Chattopadhyay, "Fast harmonic balance of SIS mixers with multiple junctions and superconducting circuits," *Proc. Tenth International Symposium on Space Terahertz Tech.*, pp. 282–297, 1999.