



## Free Computational Electromagnetic Modeling Codes

The software in this list is either free or available at a nominal charge and can be downloaded over the internet. Some of the codes require the user to register with the distributor's web site.

If you are familiar with other free EM modeling software that should be added to this list, please send the name of the software, a hypertext link, and a brief description to [CVEL-L@clemson.edu](mailto:CVEL-L@clemson.edu).

See also: [Commercial Electromagnetic Modeling Codes](#)

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### [Angora](#)

Angora is a free, open-source FDTD software package that computes numerical solutions to electromagnetic radiation and scattering problems. It was developed by Ilker R. Capoglu, a postdoctoral research fellow at the Biophotonics Laboratory in the Biomedical Engineering Department of Northwestern University.

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### ASAP - Antenna Scatterers Analysis Program

A general purpose user-oriented computer program for analysis of thin-wire structures in the presence of finite ground. An alternative to the Numerical Electromagnetics Code (NEC) for analyzing insulated or bare thin wire antenna structures over a lossy or perfect ground plane based on the moment method. Still available on the web at: <http://raylcross.net/asap/index.html>; however the web page has not been updated recently and the contact information no longer works.

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### [AtaiTec Free 2D Field Solver](#)

A 2D BEM Field Solver to compute RLGC and impedance matrices of 2D transmission lines with trapezoidal cross sections.

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### [ATLC - Arbitrary Transmission Line Calculator](#)

A free, open-source program for computing the properties of transmission lines. It is a 2D simulator based on a finite difference approximation to Laplace's Equation. The program is primarily designed for Unix or Unix-like systems, although it has been compiled on a Windows system. It is highly portable, having been run on both a Cray supercomputer, a Sony Playstation 3 games console, and virtually every type of computer in between these two extremes. The user has to draw the cross section of the transmission line using a program able to save BMP files (e.g. Gimp), then process the BMP files with atlc. The program is written by Dr. David Kirkby (G8WRB).

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### [ATLC2 - Arbitrary Transmission Line Calculator 2](#)

Inspired by 'atlc', but written by a different author, 'atlc2' is a free but closed source Microsoft Windows program for computing the properties of transmission lines. It is a 2D simulator based on Faraday's Law. The user has to draw the cross section of the transmission line using a program able to save BMP files (e.g. Gimp), then process the BMP files with atlc2.

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### [Elmer](#)

Elmer is open source multiphysical simulation software mainly developed by CSC - IT Center for Science in Finland. Elmer includes physical

models for problems in fluid dynamics, structural mechanics, electromagnetics, heat transfer and acoustics. These are described by partial differential equations that Elmer solves using the Finite Element Method (FEM).

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## [emAnalyze](#)

This was formerly the Toy and ToyBox codes. emAnalyze is a collection of 3D test and example codes for time-domain local-operator methods. The website is still under development. It is not clear if the codes are still available at no charge.

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## [EMAP](#)

EMAP is a family of three-dimensional electromagnetic modeling codes developed at the University of Missouri-Rolla and Clemson University. Each code has different capabilities, but they all have a common easy to understand input file format. EMAP2 is a scalar FEM code, EMAP3 is a vector FEM code, and EMAP5 is a vector FEM/MoM code.

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## [EMCoS Antenna VLab SV](#)

EMCoS Antenna VLab SV is a computational platform for modeling antennas and their surrounding environment. It has a CAD interface and its simulation core is based on the Method of Moments. The student version includes a fully functional EM solver limited to 2GB memory for in-core or out-of-core calculations.

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## [EM Explorer](#)

EM Explorer (EMXP) is a 3D electromagnetic (EM) solver for plane wave scattering problems of periodic structures. It is largely based on the same method of Finite Difference Time Domain (FDTD). Therefore it inherits most of FDTD's advantages and disadvantages. The advantages include simple & robust numerical algorithm, versatility for nearly any geometries, and good scalability of computing resources as a function of simulation volume size. The disadvantages are numerical dispersion and stability constraint due to the finite difference (FD) approximation to Maxwell's equations and explicit time marching algorithm.

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## [emGine Environment](#)

The emGine Environment is a full-wave 3D electromagnetic simulation environment solving Maxwell's equations in time-domain. It is used for the modeling of high-frequency electromagnetic field in microwave circuits, antennas, resonators, hollow waveguides, etc. For non-commercial and non-governmental usage, e.g., for academic, research and educational purposes, the tlmGine electromagnetic engine is provided for free in binary format (i.e., no source code is provided for the electromagnetic engine). The emGine GUI - the graphical user interface - is an open source project and is licensed under the tri-license MPL/GPL/LGPL.

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## [ERMES](#)

ERMES (Electric Regularized Maxwell Equations with Singularities) is a finite element code in the frequency domain implemented in C++. The current version of ERMES is multi-processor (OpenMP) and it runs on Microsoft Windows. ERMES has a user-friendly interface created with Tcl/Tk and integrated in the commercial software GiD.

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## [FastCap and FastHenry](#)

FastCap and FastHenry are open-source static moment method codes designed to calculate the resistance, capacitance, and inductance of 3D geometries. They were developed at the MIT Research Laboratory of Electronics.

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## [FEKO LITE](#)

A light version of the FEKO Software from EMSS. Limited to 300 unknowns. Requires user registration.

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## [FEMM - Finite Element Method Magnetics](#)

A set of programs running under Windows for the finite element solution of 2D and axisymmetric magnetic and electrostatic problems. Includes a graphical preprocessor, a solver, and a graphical postprocessor. Authored by David Meeker, Ph.D.

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## [GLMoM](#)

GLMoM is an electromagnetic field simulation code that employs the Method of Moments and Green's functions for multilayered media.

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## [gprMax](#)

gprMax is 3D FDTD software developed at the University of Edinburgh. gprMax was designed for modelling Ground Penetrating Radar (GPR) but can also be used to model electromagnetic wave propagation for many other applications. gprMax is command-line driven software written in Python with performance-critical parts written in Cython/OpenMP. It does not have a graphical user interface (GUI).

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## [GSVIT](#)

GSvit is open source FDTD software with support for the use of Nvidia CUDA environment compatible graphics cards. Main scientific purposes include research in nanotechnology and nanoscale optics, like scanning near-field optical microscopy, tip enhanced Raman scattering, rough surface scattering, etc. However, as FDTD is an universal method, it can be used for many other purposes.

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## [MMANA-GAL \(basic version\)](#)

A Microsoft Windows program, based on the method of moments, for simulating wire antennas This is based on NEC2 and is a limited version of the full MMANA-GAL program.

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## [MEEP](#)

MEEP is a free finite-difference time-domain (FDTD) simulation software package developed at MIT to model electromagnetic systems. Meep supports 1d/2d/3d/cylindrical problems, distributed-memory parallelism, dispersive and nonlinear media, PML boundaries, and is completely scriptable via both C++ and Scheme (GNU Guile) interfaces.

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## [MMTL](#)

MMTL, the Multilayer Multiconductor Transmission Line 2-D and 2.5-D electromagnetic modeling tool suite, generates transmission parameters and SPICE models from descriptions of electronics interconnect dimensions and materials properties. MMTL programs are 2-D and 2.5-D field solvers that convert dimensions and material properties into electronic design parameters. The MMTL suite consists of several programs, including lossy, loss-free, quasi-static, and full-wave simulators. Circuit parameters are computed by either the method of moments (MOM) or finite element methods (FEM). Basic per-unit-length parameters are generated by the simulator, and can be converted into HSPICE W-element models.

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## [Multiple Multipole \(MMP\) Algorithms](#)

The Multiple Multipole (MMP) algorithms were developed by Christian Hafner at the Swiss Federal Institute of Technology (ETH Zurich). The algorithms have evolved and been incorporated into the commercial code, Max-1, but the original 2D and 3D source codes are still available for free at the above link.

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## [NEC2](#)

NEC2 - the Numerical Electromagnetics Modeling code is a widely used 3D code based on the method of moments. It was developed at Lawrence Livermore National Laboratory more than 10 years ago and has been compiled and run on many different computer systems. NEC2 is particularly effective for analyzing wire-grid models, but also has some surface patch modeling capability. Codes are also available at Ray

Anderson's Unofficial Archives at [Ray Anderson's Unofficial Archives](#).

NEC2 uses a text interface. There are several free or inexpensive graphical interfaces that do pre- and post-processing of NEC2 models. A good free code is 4nec2, which can be found at <http://www.qsl.net/4nec2/>.

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## [newFasant \(silver version\)](#)

This student version includes the same functionalities as the commercial release of NewFasant, with a restriction of a maximum of 50000 subdomains for the MOM approaches, 100 surfaces for geometrical models and 25000 patch elements for the meshes. It also has a time limitation of one year, but new releases will be offered before the expiration of the previous one. This version is only available for Windows 64 bit platforms compatible with OpenGL.

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## [openEMS](#)

OpenEMS is a free and open-source electromagnetic field solver employing the FDTD method. It uses Matlab or [Octave](#) as a scripting interface. openEMS is licensed under the [GNU General Public License, Version 3 or later](#).

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## [Pic2Mag](#)

Pic2Mag is a free program that uses colors in a graphics file to represent magnetic materials with different magnetic spin moments. Based on the magnetic spin moments it calculates the vector fields, isopotential contours, and streamlines.

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## [pdnMesh](#)

pdnMesh is a program that can solve 2D potential problems (Poisson Equation) and eigenvalue problems (Helmholtz Equation) using the Finite Element Method. Common applications occur in electromagnetics, heat flow and fluid dynamics. It can solve problems using both Nodal Based Formulation and Edge Based (Vector) Formulation.

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## [Puma-EM](#)

Provides surface Method of Moments for electromagnetics, enhanced by using the Multilevel Fast Multipole Method. Code is parallelized and runs on desktops and clusters.

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## [Qsci](#)

Qsci is a MATLAB script that plots the electrostatic field generated by a set of conductors using a Method of Moments approach. You can assemble some geometries, impose a voltage or total charge on conductors and Qsci will plot surface charge density, the electrostatic potential and compute capacitances.

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## [SATE Static Field Analysis Toolkit \(Educational\)](#)

The SATE 6.2 freeware from Field Precision includes the 2D programs EStat and PerMag. The education programs have full capabilities but are limited to 12,500 nodes and 8 material regions. EStat determines electric fields in dielectric or conductive media. Advanced capabilities include support for anisotropic materials and the option to define continuous variations of potential, dielectric constant or conductivity from mathematical functions. PerMag covers all aspects of magnetostatics, including saturation effects in soft materials and permanent magnets with non-linear demagnetization curves. The package includes Mesh, an automatic conformal mesh generator with a built-in drawing editor and DXF import capability.

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## [Students' QuickField](#)

Students' QuickField(TM), formerly known as ELCUT, is a 2D finite element simulation package solving plane and axisymmetric problems of electrostatics, nonlinear DC magnetics, AC magnetics, current flow, nonlinear heat transfer, stress analysis and coupled problems on any PC.

## [Sonnet Lite](#)

A feature-limited version of Sonnet Software's planar-MOM electromagnetic simulation software.

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## [Trace Analyzer](#)

A nice 2-D solver for determining the transmission line parameters of printed circuit board trace geometries. It's capable of analyzing trace cross-sections consisting of many traces, planes and lossy dielectric materials. Can export RLGC parameters to HSPICE or ADS.

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## [Wolfsim](#)

WOLFSIM is a Finite-Difference Time-Domain electromagnetic simulator developed and maintained by researchers at North Carolina State University. The links to the documentation on the Sourceforge site are broken.

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