# NEC - Basic Scattering Code
# NEC-BSC Version 4.2

***Ronald J. Marhefka***
**The Ohio State University**
**ElectroScience Laboratory**
1320 Kinnear Road
Columbus, Ohio 43212-1191
Tel: +1-614-292-6030
Fax: +1-614-292-7297
E-mail: ***usa-codes@esl.eng.ohio-state.edu***

October 2000

The Numerical Electromagnetic Code - Basic Scattering Code (NEC-BSC V4.2) is a user-oriented computer code for the electromagnetic analysis of the radiation from antennas in the presence of complex structures at high frequency. For many practical sized structures this corresponds to UHF and above. The code can be used to predict patterns of antennas in the presence of scattering structures, to provide the EMC or coupling between antennas in a complex environment, and to determine potential radiation hazards. Simulation of the scattering structures is accomplished using combinations of multiple flat plates, finite elliptic cylinders, composite cone frustums, finite composite ellipsoids, and thin wires. The structures can be perfectly conducting or composed of multilayered materials. The plates can be transparent or opaque, that is, metal backed. The curved surfaces presently must be metal backed.

The analysis is based on uniform asymptotic techniques formulated in terms of the Uniform Geometrical Theory of Diffraction (UTD). It can be successfully used to model a wide range of practical problems. In this particular code, the antennas can be mounted on or off flat or curved surfaces, but not directly in materials. It can be used to simulate the scattering from the superstructures of a ship, the body of a truck or tank, or the fuselage, wings, and stores of an aircraft or space based structures. The material capability can be used as an isolated slab which can simulate a windshield or radome, or it can be use to coat a plate or curved surface to simulate composites or an absorber-coated ground plane, or as a semi-infinite half space to simulate the earth. The materials modification is not complete (i.e., surface waves and creeping waves are not included), but it is meant to be applied to practical problems within engineering accuracy.

Antennas are defined to be sources or receivers. If a receiver is defined, then spatial coupling between the source and receivers are calculated. In principle, any antenna can be defined since the UTD solutions are based on infinitesimal elements. If the currents are known like from a moment method code, these currents can be numerically integrated. For efficiency sake, there are various built in antenna types defined by their pattern factors. They include dipoles, rectangular, and circular apertures with various current descriptions. A linear interpolation of table look up data may also be used.

The fields may be calculated in the near or far zone of the structures. The antennas are assumed to be in the near zone of the objects. The antennas can either be fixed or moving. They can move in spherical or linear pattern traces in any incremental step size. Single pattern traces or volumetric data can be obtained. Either single or multiple frequencies can, also, be calculated.

The size of the structures should be large in term of a wavelength. The minimum size and spacing should be around one wavelength. For engineering accuracy, the sizes can be reduced to around a quarter - wavelength. The accuracy of the solution is also dependent on the number of UTD terms included for the particular problem. All terms for plates are included up to third level interaction not including double edge diffraction with intervening plate interactions at the present time. Surface waves in dielectric materials are not available either. For curved surfaces, first order terms are included for all curved surface descriptions. In addition, creeping wave terms are available for only the perfectly conducting cylinders at present. Plate-to-cylinder interactions are not presently included. The number of terms calculated in a given solution can be controlled, by specifying the type of term. Particular parts of the structures can be specified in a separate file for inclusion or exclusion through a term processor.

The NEC-BSC V4 has a User's Manual (under preparation) which is designed to give an overall view of the operation of the code, to instruct a user in how to use it to simulate the scattering from structures, and to show the validity of the code by comparing various computed results against alternative codes and measured data whenever available. The code has been designed to run on many types of computers. It is relatively fast compared to integral and differential based theories for large size objects. It is also efficient in its use of memory needing only several MBs. The NEC-BSC is presently distributed as a PC executable code for Windows 9x, or NT. It comes with an automatic installation procedure. It can, also, be supplied in Linux executable form. Other formats need to be handle on a case-by-case basis at present. The source code is considered proprietary and is not distributed. There is an unrestricted version and a restricted version of the NEC-BSC V4. The restricted version includes a limited number of additional materials types that can be handled. Only United States DOD components can qualify for the restricted version.

The NEC-BSC has a companion graphical user interface code referred to as the NEC-BSC Workbench. It is an intelligent editor for the input files with dialog boxes to aid command definition. It can also provide visualization of the geometry and NEC-BSC output files. It is not essential for operation of the NEC-BSC. It needs to be obtained separately.