Jammer Effectiveness Model

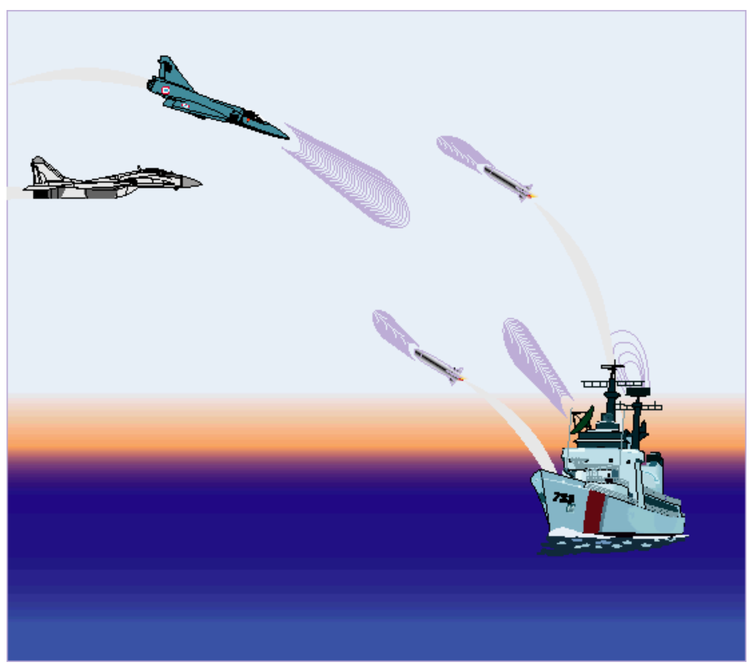
Institute for Telecommunication Sciences (ITS)

- **Windows® 95/98/NT/2000/ME/XP version of Jammer Effectiveness Model for communications and radar systems analysis in use by the U.S. Army and other Federal agencies.**
- **Multiple jammer and interferer analysis capability on a wireless network for use in performance evaluation in an electronic warfare or interference electromagnetic environment.**

ITS completed the conversion of the Jammer Effectiveness Model (JEM) to operation in the Windows® 95/98/NT/2000/ME/XP environment. JEM was developed by ITS for the U.S. Army in order to evaluate electronic warfare scenarios on a personal computer. Other programs with similar capabilities require mainframe computers. This model is a very flexible analysis tool and can be used to perform many different types of analysis, because it is highly structured and modular in design. ITS has developed two versions of JEM for systems performance evaluation in an electronic warfare environment: one for communications analysis and the other for radar analysis. Each version of JEM includes a user-created catalog of equipment, ground stations, aircraft and satellite platforms; the software for creating and maintaining this catalog; a climatological database for much of the world; a library of propagation subroutines; and the analysis software. The JEM propagation library includes subroutines for use in calculating clear-air attenuation, rain attenuation, multipath attenuation, diffraction losses, and troposcatter losses. The valid frequency range of the communication version of JEM is currently 2 MHz to 300 GHz, while that of the radar version is currently 30 MHz to 20 GHz.

JEM uses scenario descriptions to completely characterize a communication link or radar configuration with or without a jamming situation. Data entry to create a scenario description is simplified by the use of user-friendly menus and options. Each scenario description is saved in a database, and includes: ground or airborne station location, three-dimensional geometry description, equipment characteristics, and physical factors such as climate and terrain. JEM contains an inventory of specific analyses that can be performed on the physical configurations represented by the scenario description data.

The communications analysis version of JEM is primarily used to model communication systems in electronic warfare scenarios where these systems are being jammed or interfered with. This version of JEM is organized into six scenarios, each of which represents either a communication path geometry description or a jamming geometry description. The four scenario types in the communication geometry description are: ground-to-ground, ground-to-satellite, ground-to-aircraft, and aircraft-to-satellite. The two scenario types in the jamming geometry description are jamming and jammer versus network. The jamming scenario analyzes: received jammer power versus distance, received transmitter power versus distance, jammer footprint, and isopower contours. The jammer versus network scenario analyzes and evaluates the effects of up to three jammers on up to five communications nodes. For the jamming geometry description, the receiver, transmitter, and jammer platforms can be on the



Aircraft with standoff and self-screening jammers avoiding detection by a shipboard fire-control radar and radar-guided missiles (illustration by A. Romero).

ground or airborne.

The jamming and jammer versus network scenarios are the major features of JEM for electronic warfare and interference analysis. The other four scenario types are used to help evaluate and design microwave communication systems. They allow the user to simulate a wide variety of propagation effects on the system that occur in the higher frequency ranges by including clear-air absorption losses and losses due to rain attenuation. In FY 2000, three-dimensional antenna pattern capability was added to JEM.

The radar version of JEM allows radar analysis for different combinations of radars and jammers that are on the ground or carried by airborne stations. The radar scenario analyses consist of evaluating the performance of a radar trying to detect and track a target. The analyses can be performed both with and without the presence of a jammer. A scenario includes the jamming of an airborne radar by a ground-based or airborne jammer to protect potential targets that can either be collocated with the jammer or separated from the jammer. The three-dimensional geometry of these radar scenarios requires three-dimensional antenna patterns, included in the analysis models.

There are three analysis modes available in the radar jamming scenario: a radar jammer footprint, a radar isopower contour, and a radar burn-through range. For the radar jammer footprint analysis a jammer is able to jam a radar that is on or within a contour of distance to jammer versus azimuth angle, and prevent it from detecting a target. The isopower contour analysis is a plot of signal power density about the radar or jammer versus distance and azimuth angle about the radar or jammer. The radar burn-through range analysis is the minimum range to the target versus azimuth angle at which the target is obscured by jamming. It is also the maximum range versus azimuth angle at which the radar detects the target.

The Figure illustrates two aircraft, a stand-off jammer and a self-screening jammer, attempting to avoid detection by a shipboard fire-control radar and a radar located in the guided missiles. The shipboard fire-control radar will detect the aircraft and inform the missiles of its location. The radar guidance systems on the missiles will provide terminal guidance to the missiles to destroy the aircraft targets. The stand-off jammer is protecting other airborne targets by jamming both the shipboard and missile radars. The self-screening jammer is protecting itself from detection by the shipboard radar and the missile radar guidance systems. The JEM software allows performance prediction of the jammers' ability to avoid detection in this scenario.

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