MSAM

Microcomputer Spectrum Analysis Models

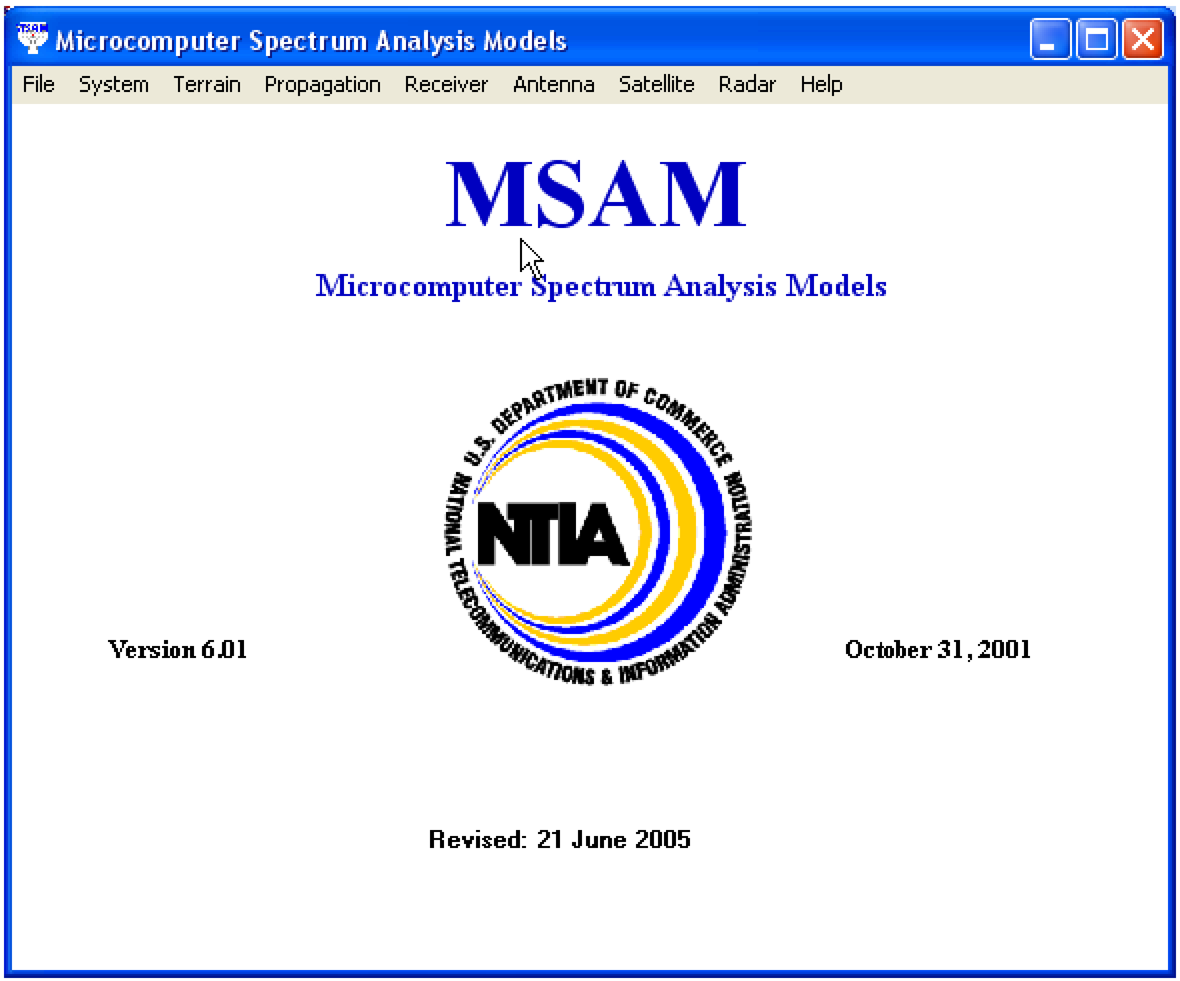
MSAM

- The Microcomputer Spectrum Analysis Model (MSAM) is a collection of programs useful for spectrum management, radio wave propagation and communications engineering.

MSAM

- 14 Models
- 7 Categories
- 3 Terrain Databases
- Help Files

MSAM


Microcomputer Spectrum Analysis Models
File System Terrain Propagation Receiver Antenna Satellite Radar Help
MSAM
Microcomputer Spectrum Analysis Models
U.S. DEPARTMENT OF COMMERCE
NTIA
NATIONAL TELECOMMUNICATIONS & INFORMATION ADMINISTRATION
Version 6.01
October 31, 2001
Revised: 21 June 2005

MSAM

- File Menu
  - Select terrain database - USGS (3 sec), Globe (30 sec) or DTED Level1 (3 sec)
- System Menu
  - INTMOD - Intermodulation
  - SEAM - Single Emitter Analysis Model

MSAM

- Terrain Menu
  - BDIST – Bearing/Distance
  - PROFILE - Profile
  - HORIZON - Horizon
  - SHADO – Shado (Line-of-Sight)
- Propagation Menu
  - ITM - Irregular Terrain Model
  - LMS – Land Mobile Service

MSAM

- Receiver Menu
  - FDR - Frequency Dependent Rejection
- Antenna Menu
  - APD - Antenna Power Density
- Satellite Menu
  - SATAZ - Satellite Azimuth
  - A7 - APPENDIX 7

MSAM

- Radar Menu
  - RSEC – Radar Spectrum Engineering Criteria
- Help Menu

MSAM

Installation CD

- MSAM Installation Setup
  - MSAM.exe
- Terrain Databases
  - Globe folder
- Geographic Map Database (Appendix 7 model)
  - NTIA Geo Data folder
- Installation Documentation
  - MSAM Installation Guide.doc

Propagation Models

MSAM

ITM

Irregular Terrain Model

- Estimates radio propagation losses over irregular terrain for VHF, UHF and SHF frequencies as a function of distance and the variability of signal in time and space
- Based on electromagnetic theory and signal loss variability expressions derived from extensive sets of measurements
- Two modes:
  - Area prediction mode
  - Point-to-point mode

MSAM

ITM

- Area Mode
  - Terrain irregularity parameter is needed and the output is either a table of transmission losses in dB vs. distance for several confidence levels or graphs of dB loss vs. distance for specified confidence levels.
- Point to Point Mode
  - Requires terrain data and the path coordinates are specified.
  - Output is a list of estimated transmission losses for specifies values of reliability and confidence levels.
  - Output screen also contains a snapshot of the terrain profile.

MSAM

ITM

Area Mode

(Normal Calculation)

MSAM

ITM

Area Mode

(Inverse Calculation)

MSAM

ITM

Point to Point

MSAM

LMS

Land Mobile Service

- Package of empirical models for terrestrial land mobile services
- Models used
  - Okumura/Hata/ITU-R529
  - COST231
  - Okumura-Hata-Davidson
- Calculates
  - Path loss
  - Received field strength
  - Field strength vs distance

MSAM

Frequency (MHz)

		$30 \le F < 150$	**$150 \le F < 1500$**	**$1500 \le F \le 2000$**
$d \le 100$km	**$hb \le 200$m**	Davidson	ITU 529	Cost 231
$d \le 100$km	**$hb > 200$m**	Davidson	Davidson	X
$d > 100$km	**$hb \le 200$m**	Davidson	Davidson	X
$d > 100$km	**$Hb > 200$m**	Davidson	Davidson	X

MSAM

Terrain Models

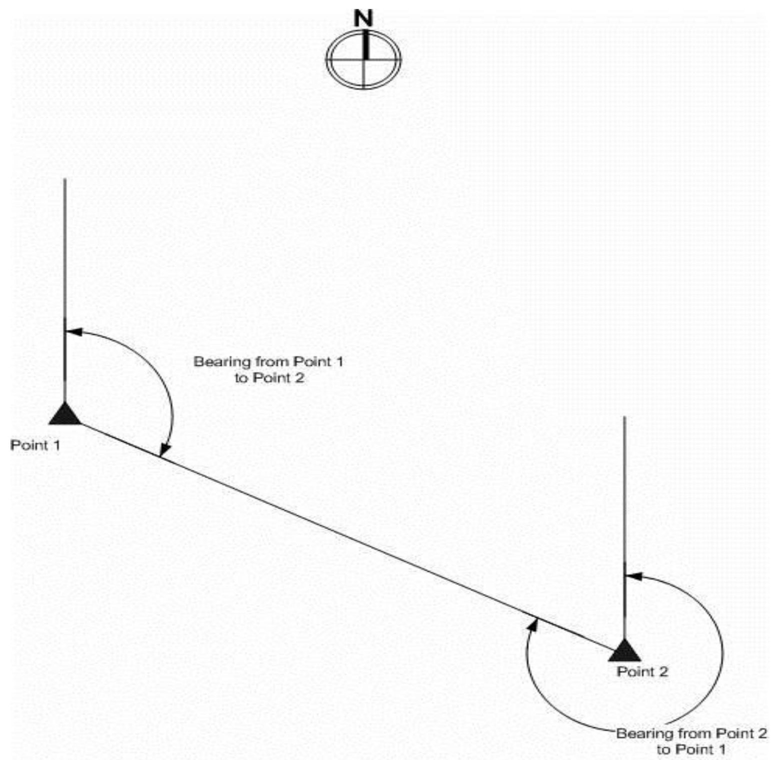
MSAM

BDIST

Bearing And Distance

- Calculates bearing angles & distance between two points on the earth's surface

MSAM



Bearing Measurements Between Two Points

MSAM

PROFILE

- Calculates and displays a profile of elevations between 2 locations
- Terrain databases:
  - Globe
- Displays:
  - take-off angle
  - receiving angle
  - distance to the radio horizon
  - distance from the radio horizon.

MSAM

HORIZON

- Calculates the radio line of sight distances and elevation angles 360° around a transmitter or receiver site
- Terrain databases:
  - Globe
- Generates two plots:
  - Radio Horizon Distance
  - Elevation Angle

MSAM

SHADO

- Antenna coverage model
- Plots areas that are within the radio line of sight of an antenna
- Terrain databases:
  - Globe
- Allows for analysis of propagation loss
- May specify 1 or 2 antennas

MSAM

System Models

MSAM

INTMOD

Intermodulation

- Computes intermodulation products and harmonics of a list of transmitted frequencies
- Compares them to a list of receiver frequencies to determine overlap
- Two & three signal mixing of 3rd, 5th & 7th order can be computed

MSAM

SEAM

Single Emitter Analysis Model

- Supports user-interactive computations & automated unit conversion in direct & inverse modes
- Two computation modes
  - Direct
    - Estimates received signal levels at a user specified propagation distance
  - Inverse
    - Estimates propagation distance required to meet a user specified received threshold
- Two models
  - Free space
  - Smooth earth (IPS)

Receiver Models

MSAM

FDR
Frequency Dependent Rejection

- Amount of attenuation offered by a Rx to a transmitted signal
- Attenuation has two parts
  - On-tune rejection (OTR)
  - Off frequency rejection (OFR)
- Performs 2 computations
  - FDR
  - Frequency-Distance (F-D) relationships between Tx and Rx
- FDR calculated using the Gauss-Legendre Quadrature integration method
- F-D distance calculated for each frequency using Smooth Curve – Smooth Earth or Free Space propagation model

MSAM

Antenna Models

MSAM

APD
Antenna Power Density

- Provides simplified procedures for estimating the near field power density of a number of common types of antennas
- Graphically checks the compliance of systems with different emission exposure standards or user-defined limits
  - OSHA
  - ANSI C95.1-1991
  - FCC 1.1310
  - NCRP (National Council on Radiation Protection)
- Output
  - Distance
  - Power density

Satellite Models

MSAM

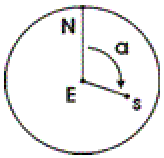
SATAZ

Satellite Azimuth

- Computes direction and distance from an earth station to a satellite (geo-stationary or non-geostationary)
- Takes into account ray bending due to the atmosphere
- Output
  - Azimuth angle
  - Elevation angle
  - Satellite pointing angle
  - Slant range from an earth station to the orbiting satellite

MSAM

Azimuth Angle



Angle a (in the diagram) is the azimuth angle from the earth station to the satellite relative to true North (west is positive) where:

E = Earth Station

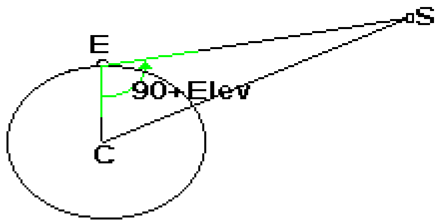
s = Sub-Satellite point

N = North Pole

a = Azimuth Angle clockwise from true north

MSAM

Original Elevation Angle



The original elevation angle (Elev) is the angle upwards that the earth antenna must point (Does not include ray-bending correction), where:

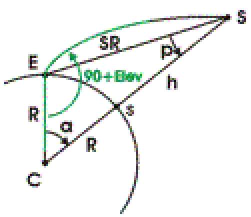
E = Earth station

S = Orbiting satellite

C = Center of earth

MSAM

Corrected Elevation Angle



The original elevation angle (Elev) is the angle upwards that the earth antenna must point (Does not include ray-bending correction), where:

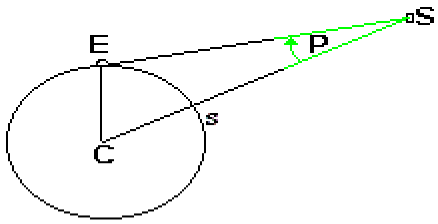
E = Earth station

S = Orbiting satellite

C = Center of earth

MSAM

Satellite Antenna Pointing Angle



The satellite antenna pointing angle (P) is the angle between the lines joining the satellite to the earth station and the satellite to the sub-satellite point where,

E = earth station

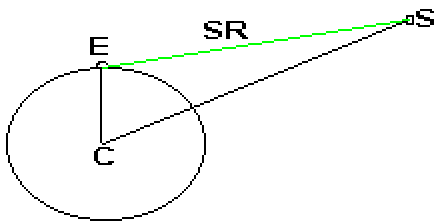
S = Orbiting satellite

C = Center of Earth

s = Sub-Satellite point

MSAM

Slant Range



The slant range (SR) is the straight line distance between the earth station and the orbiting satellite where,

E = Earth station

S = Orbiting satellite

C = Center of earth

MSAM

Appendix 7

- Calculates the earth station coordination contours
- Uses ITU-R Rec SM 1448
- ITU-R Rec 620-3 propagation model
- Displays contours on a map
- Uses WOTL or Globe terrain data
- Uses NTIA Geographic Map data (C:\NTIA Geo Data\)

MSAM

Contacts:

- Technical issues
  - Alaka Paul
    - (202) 482-1652
    - apaul@ntia.doc.gov
- Software issues
  - Sophie Zhao
    - (202) 482-4983
    - xzhao@ntia.doc.gov