A Matlab Program for Predicting the Antenna Wetting Effects of the ACTS 1.2-meter Antenna

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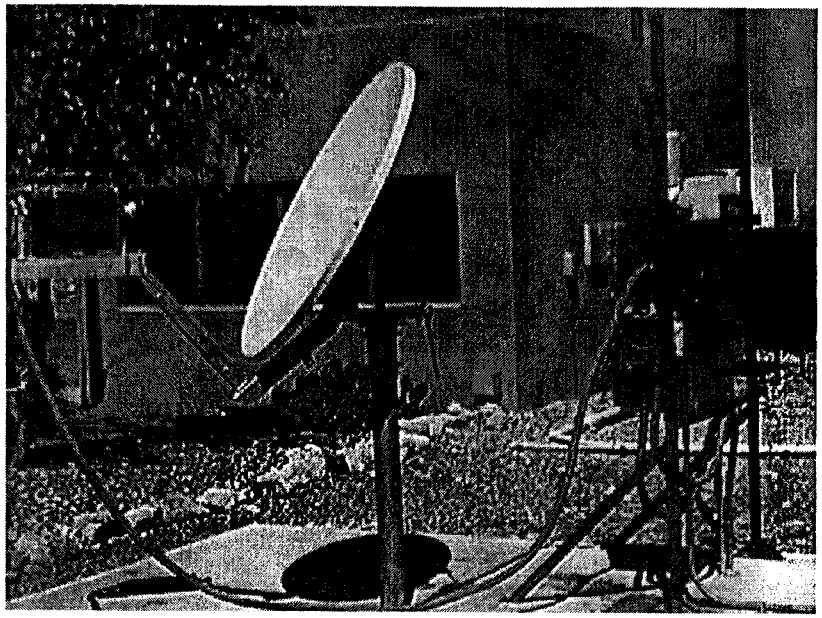
Topics

- Background
- Computation Methodology
- Configuration
- Output
- References

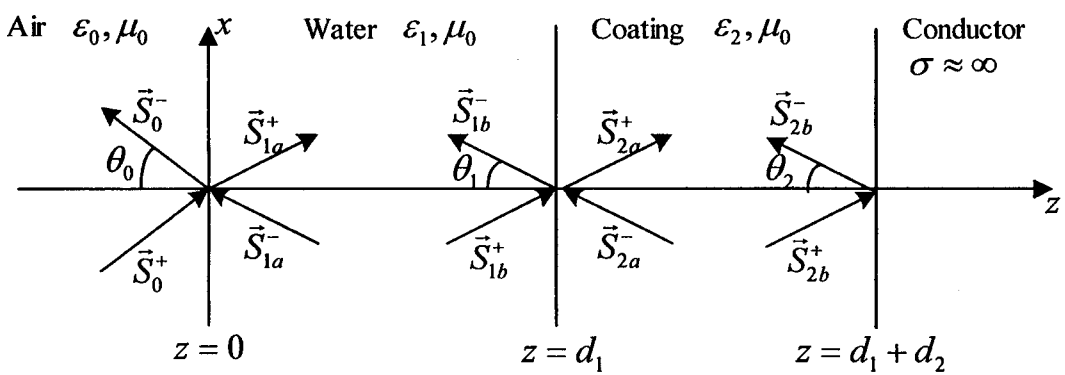
Background

- As part of the ACTS Experiment Program, it was discovered that the antenna was subject to wetting effects due to its fabrication methodology



Background

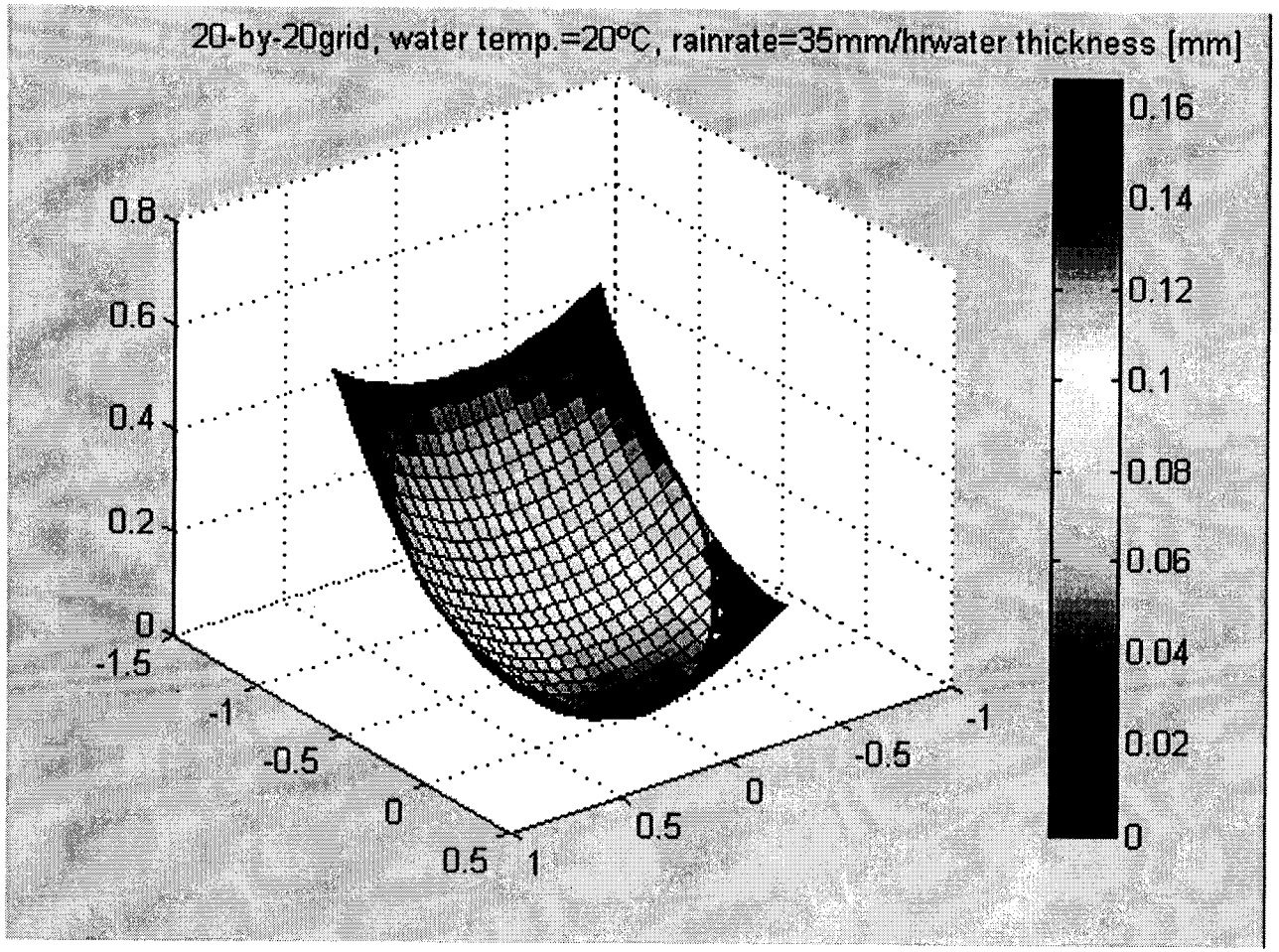
- A computational model was developed to determine the attenuation on a multi-layer surface including effects from coating layers, water layers, and surface roughness



Background

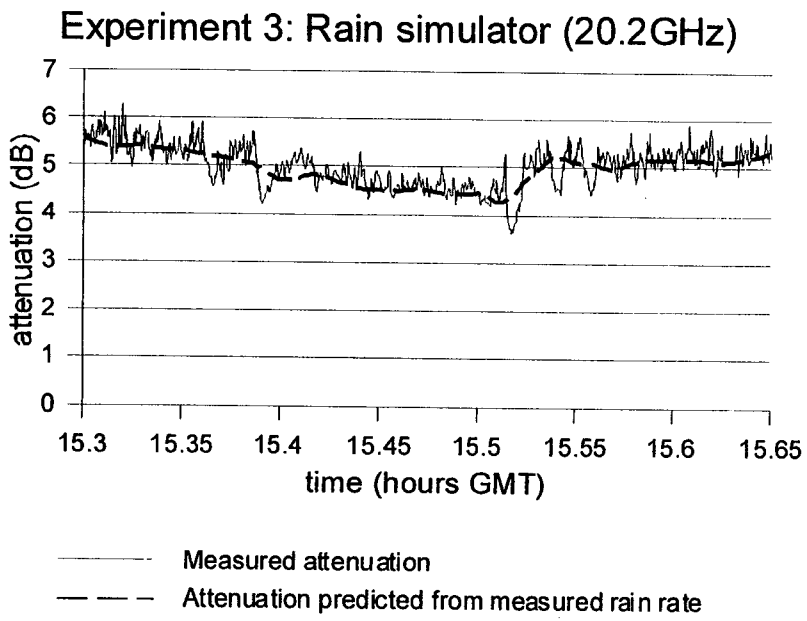
- Computational model divides the surface into a grid and
  - computes water thickness as a function of rain rate
  - computes the signal transfer at each grid location across the dish
  - sums the results over all the elements

Background


20-by-20grid, water temp.=20°C, rainrate=35mm/hrwater thickness [mm]
0.8
0.6
0.4
0.2
0
-1.5
-1
-0.5
0
0.5
1
0.5
0
-0.5
-1
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0

Background

- Model validated against measurements made with the New Mexico APT hardware using the rain machine



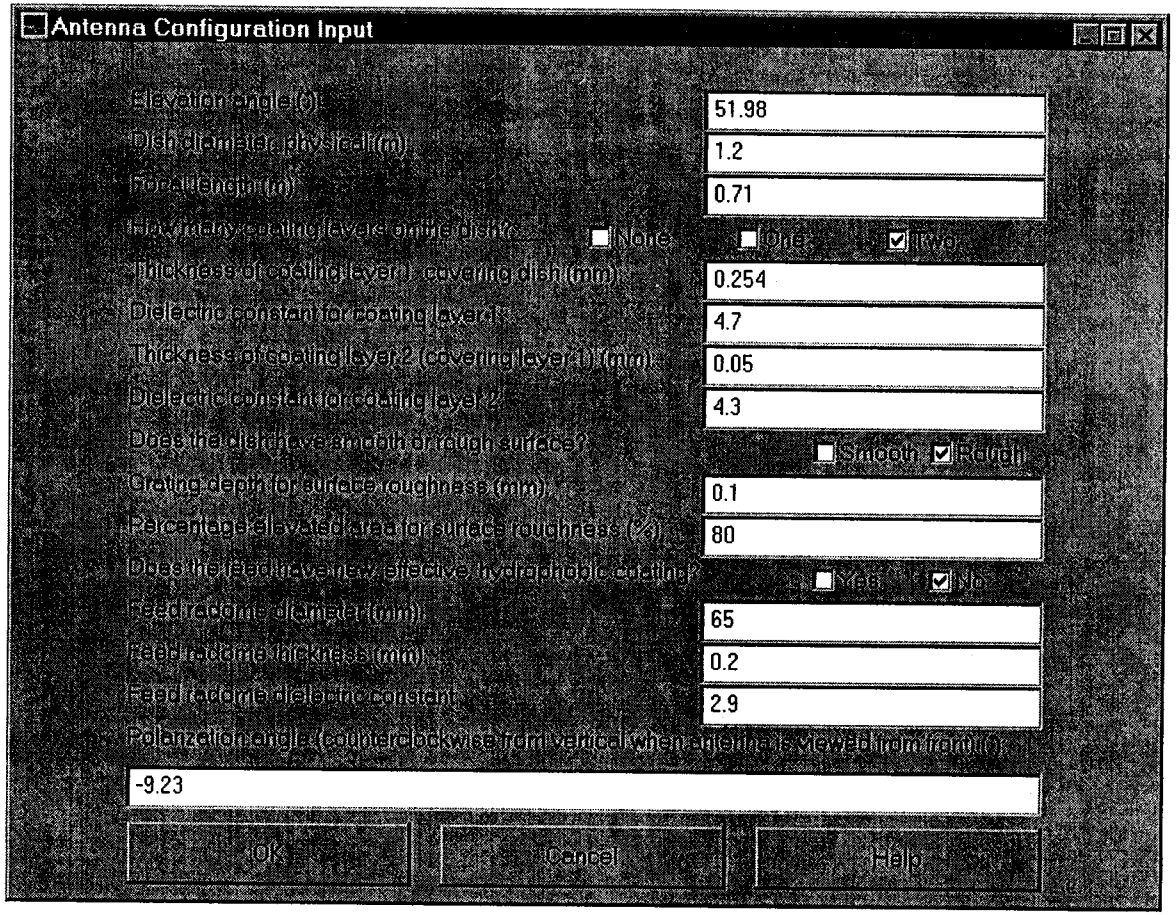
Computation Methodology

- Use Matlab user interface to prompt user for input data
- Use Matlab to perform the computations
  - estimates the water thickness on the antenna
  - computes the attenuation as a function of input parameters
  - generates output plot and table

Configuration

- The user needs to specify the antenna details
  - antenna & feed characteristics
  - coating layers
  - surface roughness
  - elevation angle
  - signal polarization angle

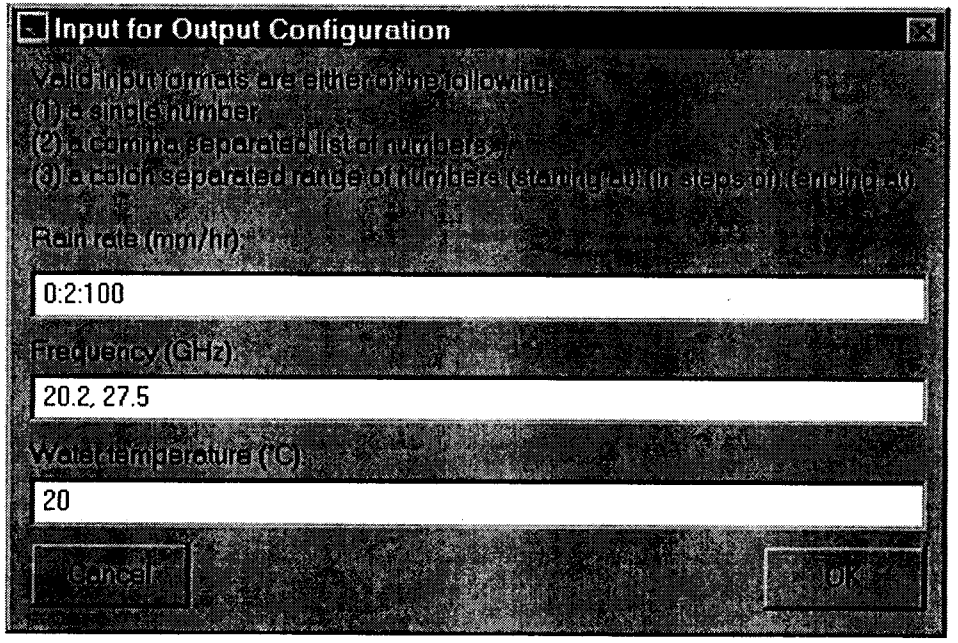
Configuration



Configuration

- Attenuation parameters
  - rain rate
  - frequency
  - water temperature
- These can be input as a single parameter, a range, or a list
- Computations over ranges produce multiple outputs

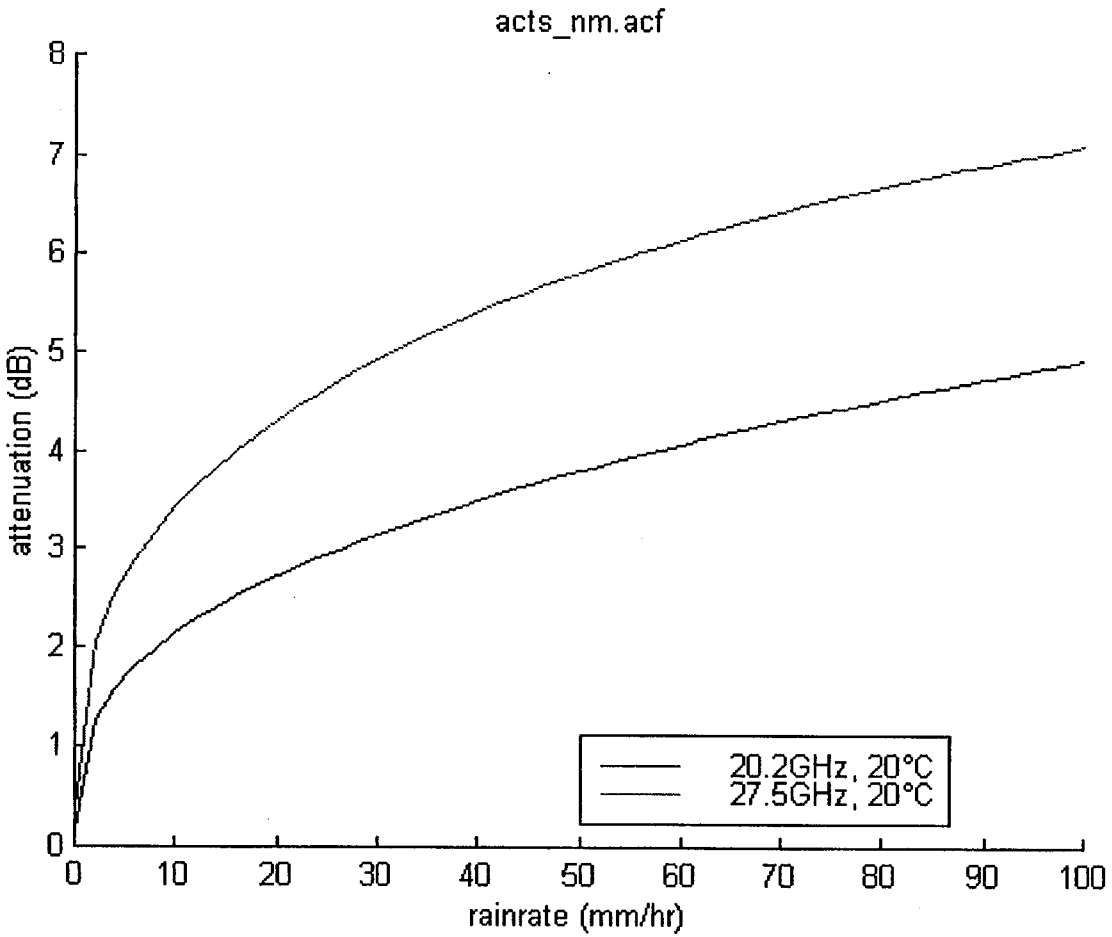
Configuration



Output

- Graphical and text outputs are available
  - attenuation graphs
  - tabular data for use in spreadsheets

Output


acts_nm.acf
attenuation (dB)
rainrate (mm/hr)
0
1
2
3
4
5
6
7
8
0
10
20
30
40
50
60
70
80
90
100
20.2GHz, 20°C
27.5GHz, 20°C

References

- Detailed computation methodology (MSEE thesis)
  http://telsat.nmsu.edu/~shoran/apt/thesis.PDF
- Matlab program
  http://telsat.nmsu.edu/~shoran/apt/wetdish.zip