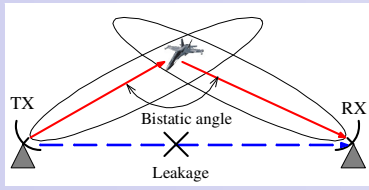


Forward Scatter Cross Section - Theory



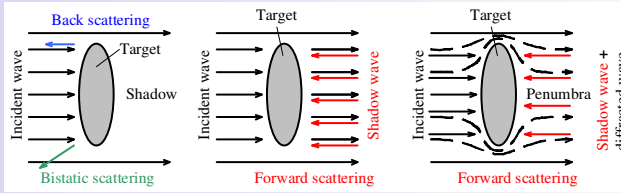
Bistatic radar (leakage is mainly cancelled)



Forward scatter radar (leakage is principally present)

In FSR the target does not reradiate incident wave but shadows direct leakage signal between transmitter (TX) and receiver (RX)

Difference in scattering mechanisms

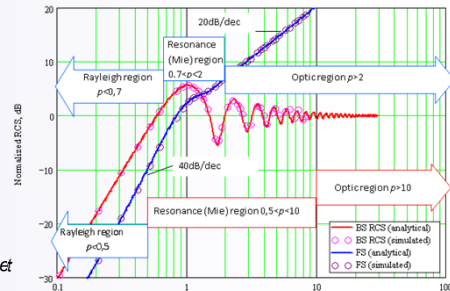


a) for electrically large target (optical model); b) for electrically small target

For electrically large target the shadow power is defined by the optical model as the radiation of plane antenna with the projected shape area and power density flow equal but opposite in phase to the incident wave:

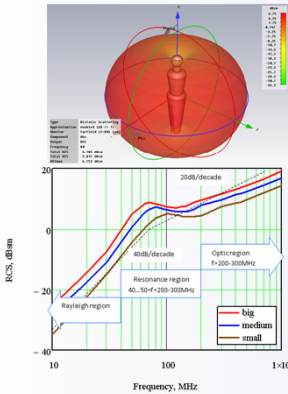
$$\sigma = 4\pi(A/\lambda)^2.$$

For electrically smaller target the wave diffraction around the target body reduces FS CS and change the phase of shadow wave. In common case FS CS can not be predicted analytically and should be defined by EM simulation

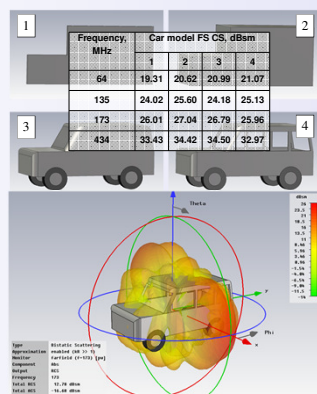


RCS of the sphere: 3D EM simulation (by CST Studio Suite) gives the same result as analytical solution for simple shapes and should be used for complex targets in Rayleigh and Mie diffraction regions

3D Electromagnetic Simulation of ground and sea targets



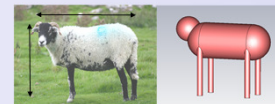
3D FS CS pattern of a human model – omnidirectional at the resonance



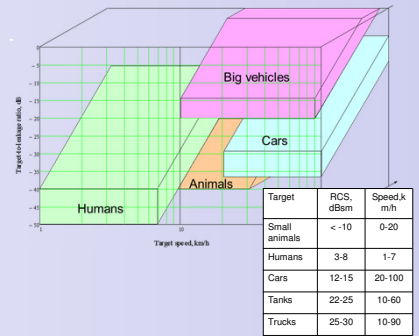
EM model of a car with different detailing and 3D FS CS pattern



EM model of a battle tank



EM model of a sheep



Target classification by FS CS and speed

Different targets FS CS tests



FS CS measurement of a boat in comparison to known sphere



FS CS tests of animal models on the chassis of radio controlled car toy



FS CS measurements of different cars



Human targets tests at different conditions

Conclusions

- The value of monostatic, bistatic or forward scatter RCS for complex targets cannot be calculated analytically if the scattering is observed in Rayleigh or Mie regions (except some simple shapes with center or axial symmetry).
- The electromagnetic simulation of target RCS gives adequate estimation of RCS value confirmed by analytical solutions for simple shapes and by a lot of real complex shape target tests as well.
- Simulated values of RCS allow to predict radar power budget for different targets.
- The form of RCS pattern gives the understanding of a target signal observed at different viewing angles.
- The measured difference in target RCS may be used for separation between targets of interest (personnel, cars, vehicles, etc.) and useless targets (small animals, birds) and as primary stage of target classification process.

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