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Perspective

Techniques Involved in Propagation of Millimeter Wave Bands

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DESCRIPTION

Millimeter waves have many advantages over microwaves such as broad bandwidths, higher spatial resolution, low probability of interference/ interception and small antenna and equipment size. Their ability to penetrate clouds, smoke, dust and fog make them a logical choice over IR and optical wavelengths for adverse weather applications. For those reasons, millimetre waves have tremendous application potential in the field of radar, radiometry, missiles, communications, spectroscopy and altimetry. A system designer should desire a reliable system with high resolution, high signal-to-noise ratio and less noise and interference susceptibility. Accordingly, systems can be designed which yield higher throughput. But, all the efforts will be at a loss, unless, the millimetre wave systems are corrected for atmospheric effects. These atmospheric effects are highly localized in terms of space and time, making their estimation a highly complex phenomena So, this thesis aims at some of the studies and estimation of propagation and noise effects imposed by the atmosphere at millimetre wave band.

The absorption bands in terms of percent atmospheric transmission versus frequency. It is to be noted that in the 1-10 GHz (3-30cm) region the transmissivity approaches 100%, thus, essentially independent of the cloud cover or precipitation. As the frequency is increased within the millimetre wave band, the attenuation increases. Around 22 GHz there is a water vapour absorption band that reduces transmission to about 85% while near 60 GHz the oxygen absorption band essentially prevents any signal reaching the surface from satellite borne transmitters.

The different propagation impairment mechanisms due to atmosphere can be broadly classified into two major groups one is clear sky effects and degraded sky effects. Again, the clear sky effects are mainly caused by gaseous absorption mechanism, while degraded sky effects are due to liquid water and precipitations Therefore, progress will be reviewed in the following areas. In clear weather, radio waves above 3 GHz experience absorption by water vapour, oxygen and other gases such as ozone, sulphar dioxide, carbon monoxide etc. But, due to low molecular densities of ozone. Carbon monoxide, only water vapour and oxygen contributions are basically significant above 3 GHz.

At the lower part of millimetre wave band, the models of waters showed good agreement with the experimental ground based radiometric observations of clear and cloudy conditions at 21 GHz, 32 GHz and 90 GHz. Additionally the gases specially, water vapour has severe effect on atmospheric refractive index. The change in refractive index produces range errors in radar altimetry and imagers. The correction of water vapour induced range errors in spaceborne-radar altimeters, presents considerable difficulties. Model based predictions are sufficiently accurate for some applications and several models are now available in millimetre wave area.

CONCLUSION

One such Millimetre Wave Propagation Model (MPM) of Liebe is now widely used, and was recently modified to include the zeeman effect. A radiowave suffers more attenuation due to raindrops with the increase of its frequency when its wavelength is comparable to the size of the raindrop. The effect is not significant upto a frequency of 10 GHz. But, above 10 GHz, the effect of drop size become increasingly important. Multi-frequency millimetre waves, IR and optical measurements, whereas have deduced the height profiles of drop size using doppler radar techniques.

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