DOWNLOAD PDF ATMOSPHERIC PROPAGATION AND REMOTE SENSING IV

Chapter 1 : Atmospheric Propagation IV | () | Publications | Spie

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Boris Show Abstract The fluid dynamics of airflow through a city controls the transport and dispersion of airborne contaminants. This is urban aerodynamics, not meteorology. The average flow, large-scale fluctuations and turbulence are closely coupled to the building geometry. Buildings create large "rooster-tail" wakes; there are systematic fountain flows up the backs of tall buildings; and dust in the wind can move perpendicular to or even against the locally prevailing wind. Requirements for better prediction accuracy demand time-dependent, three-dimensional CFD computations that include solar heating and buoyancy, complete landscape and building geometry specification including foliage and, realistic wind fluctuations. This fundamental prediction capability is necessary to assess urban visibility and line-of-sight sensor performance in street canyons and rugged terrain. In an emergency, on the other hand, prediction technology to assess crisis information, sensor performance, and obscured line-of-sight propagation in the face of industrial spills, transportation accidents, or terrorist attacks has very tight time requirements that suggest simple approximations which tend to produce inaccurate results. In the past we have had to choose one or the other: It produces HPC-quality results for airborne contaminant scenarios nearly instantly and has unique new capabilities suited to sensor optimization. This presentation treats the design and use of CT-Analyst and discusses the developments needed for widespread use with advanced sensor and communication systems. Fiorino ; Richard J. Bartell ; Glen P. Perram ; Matthew J. Cusumano Show Abstract The directed energy modeling and simulation community can make important direct contributions to the joint warfighting community by establishing clear and fully integrated future program requirements. Beam spread effects due to thermal blooming caused by the various absorbers are considered when appropriate. Power delivered in a 5 cm diameter circular area normalized by the total transmitted power is the primary performance metric used in the study, with results presented in the form of histograms. The expected performance of laser systems operating at both low and high powers is assessed at 24 wavelengths between 0. Scenarios evaluated include both up and down looking generally oblique engagement geometries over ranges up to meters in which anticipated clear air aerosols and thin layers of fog, and very light rain are simulated. Seasonal and boundary layer variations summer and winter for nighttime conditions for a range of relative humidity percentile conditions are considered to determine optimum employment techniques to exploit or defeat the environmental conditions. In addition to realistic vertical profiles of molecular and aerosol absorption and scattering, correlated optical turbulence profiles in probabilistic percentile format are used, a feature unique to HELEEOS. Al-Akkoumi ; Robert C. Huck ; James J. Sluss Show Abstract Free Space Optics FSO technology is currently in use to solve the last-mile problem in telecommunication systems by offering higher bandwidth than wired or wireless connections when optical fiber is not available. Incorporating mobility into FSO technology can contribute to growth in its utility. Tracking and alignment are two big challenges for mobile FSO communications. We introduce tracking algorithms for achieving Line of Sight LOS connectivity and present analytical results. Two scenarios are studied in this paper: After initial vehicle locations have been coordinated, the tracking algorithm will steer the gimbals to maintain connectivity between the two vehicles and allow high-speed communications to occur. Using this algorithm, data, voice, and video can be sent via the FSO connection from one vehicle to the other vehicle. Wiltse Show Abstract Atmospheric attenuation is one of the most significant factors in limiting the performance of millimeter-wave and terahertz systems. Although atmospheric propagation is fairly well understood up to 1 THz, major errors have been published in numerous locations showing atmospheric propagation at frequencies from 10 GHz to 1 THz. Some of these errors have been reported in the past by the present author. Several cases are discussed here, involving clear-air

conditions, rain, and fog. In one example, the attenuation at 4 km elevation has been mislabeled as m or 30, feet for the 10 to GHz range. In another case the attenuation peak near The third case deals with errors pertaining to attenuation in fog for frequencies between 10 and GHz. Specific information and corrections will be given for all three cases. The net result of these errors is that development of sensor and communications applications has been impeded because the errors usually make atmospheric losses appear to be greater than they really are. We present and analyze transmission data from an outdoor collinear, coaxial, multi-wavelength laser test bed comparing 1. This is achieved using lasers with average power ranging from 1 mW Mid-IR QCL to tens of milliwatts which have been normalized under lock-in detection. We also present corroborating results from an indoor fog experiment simulating various fog types. Using Mie predictions we determine and measure the extent by which a Mid-IR system scatters light less under fog than a traditional Near-IR one, hence accounting for the performance enhancement in the metro-air test bed. Alan Harris ; Tayeb A. Giuma Show Abstract Free-space optical FSO communication links are envisioned as a viable option for the provision of temporary high-bandwidth communication links between moving platforms, such as a ground station and a mobile aerial platform such as an unmanned aerial vehicle. One of the limitations of FSO links is the transmission of laser beams through various weather phenomena. One technique to attempt to overcome the effects of weather, such as fog, is to implement a wavelength diversity scheme between the FSO transmitter and receiver. This paper investigates the minimization of link acquisition times using a wavelength diversity scheme between mobile FSO platforms. The wavelength diversity scheme consists of three different wavelengths, 1. Each wavelength has different advantages and disadvantages for transmission depending of prevalent weather conditions and atmospheric turbulence conditions. A model of a ground-to-air FSO link is developed in order to predict the beam profile in the receiver plane. A simulation analysis of the transmission properties of the wavelength diversity schemes will be presented. Based on the transmission properties, a method for minimizing link acquisition times through the exploitation of various properties of each wavelength is presented and analyzed. Andrews ; Ronald L. Phillips ; Richard J. Sasiela; Ronald Parenti Show Abstract In this paper we discuss several models for the probability density function pdf of the irradiance of a Gaussian-beam wave from ground to space. We consider cases of tracked beams and untracked beams, both of which involve a certain amount of beam wander. The various pdf models that we introduce are all compared with simulation data over a broad range of beam diameters. This is true for tracked beams as well as untracked beams. Two new pdf models, developed here as a modulation of either the gamma-gamma pdf or the gamma pdf, are shown to provide excellent fits to the simulation data over all three regimes defined above. The optical scintillation as a function of the number of beams and the frequency response were measured, and the uplink and downlink laser transmission results were obtained. Wilson ; Joseph Kovalik ; Abhijit Biswas ; William Roberts Show Abstract Optical communications is a key technology to meet the bandwidth expansion required in the global information grid. High bandwidth bi-directional links between sub-orbital platforms and ground and space terminals can provide a seamless interconnectivity for rapid return of critical data to analysts. This sq-m facility houses a state-of- the-art 1-m telescope and is used to develop operational strategies for ground-to-space laser beam propagation that include safe beam transmission through navigable air space, adaptive optics correction and multi-beam scintillation mitigation, and line of sight optical attenuation monitoring. JPL has received authorization from international satellite owners to transmit laser beams to more than twenty retro-reflecting satellites. This paper presents recent progress in the development of these operational strategies tested by narrow laser beam transmissions from the OCTL to retro-reflecting satellites. We present experimental results and compare our measurements with predicted performance for a variety of atmospheric conditions. Baker ; Kevin R. Bock Show Abstract The two approximate solutions to the stochastic wave equation governing propagation through atmospheric turbulence applicable in weak scintillation conditions are reviewed. Then, an extensive set of numerical solutions are shown to test the ability of the 2 approximate solutions in predicting scintillation and the irradiance probability density function for a wide variety of beam propagation examples. The non-log normal irradiance behavior associated with one of

the approximate solutions is noted and verified by the numerical data. Grayshan ; Cynthia Y. Young ; Kenneth J. Grant ; Linda Wasiczko ; Harris R. Burris; Christopher Moore ; Rita Mahon ; Michele Suite ; Charmaine Gilbreath Show Abstract Current mathematical models describing laser propagation through the atmosphere were developed for terrestrial environments. An atmospheric index of refraction power spectrum specifically tailored to the marine environment has been created and applied to scintillation theory. Optical measurements of a diverge laser beam propagating in a marine environment, in combination with scintillation theory and a numerical scheme, were used to infer the refractive index structure parameter, Cn2, along the propagation paths. The analysis was repeated for both marine and terrestrial theoretical scintillation expressions, each resulting in one set of inferred Cn2-values. Italo Toselli ; Larry C. Phillips ; Valter Ferrero Show Abstract Atmospheric turbulence induces significant variation on the angle-of-arrival of laser beams used in free space laser communication. Unfortunately several experiments showed that Kolmogorov theory is sometimes incomplete to describe atmospheric statistics properly. Also our non Kolmogorov spectrum includes both inner scale and outer scale effects. Wasiczko ; Christopher I. Moore ; Harris R. One of the goals of our research program is to characterize the behavior of the maritime environment for lasercomm systems, and use the data gathered from the Lasercomm Test Facility LCTF at NRL-Chesapeake Bay Detachment CBD to develop a method of predicting the global availability of maritime lasercomm. The LCTF has provided volumes of information about maritime laser propagation and atmospheric turbulence. Highlights of the work on the characterization of the maritime atmosphere are provided in this paper. Scharpf Show Abstract The U. Over the past year, a comparison study between packet error rates and bit error rates has been performed. These are the two most common methods to characterize the quality of an FSO lasercom link. Results from this study will be presented. Gimmestad ; David W. Roberts ; John M. Stewart ; Jack W. Wood Show Abstract We are developing a new type of lidar for measuring range profiles of atmospheric optical turbulence. The lidar is based on a measurement concept that is immune to artifacts caused by effects such as vibration or defocus. Four different types of analysis and experiment have all shown that a turbulence lidar that can be built from commercially available components will attain a demanding set of performance goals. The lidar is currently being built, with testing scheduled for summer Chang ; Carlos O. The second location is over the dry desert in central New Mexico.

Chapter 2 : SPIE Remote Sensing

Worldwide estimates and uncertainty assessments of laser propagation for diverse geometries for paths in the altitude regime of 3 km and below at wavelengths to Âµm.

Browell Show Abstract Since the early s, airborne laser systems have been used for making remote measurements of ozone, water vapor, and aerosols in studies of many important atmospheric processes. Advanced airborne systems are under development to demonstrate autonomous operations of these laser systems and to expand their measurement capabilities. In the near future, laser systems will be used in space to investigate a wide variety of global atmospheric processes. This paper describes the current measurement capabilities of airborne laser systems, the use of these systems in recent atmospheric investigations, and the development of advanced lidar systems for aircraft and spacecraft. Light-scattering nephelometers have been used for over 15 years to infer concentration and particulate perturbations. These particle concentrations can also be remotely sensed by ocean penetrating lidar. The particulate concentrations relate to the turbidity of the water, increasing the backscattering and attenuation of incident laser radiation; the attenuation is usually characterized by K, the diffuse attenuation coefficient. Fred Holmes; Badih John Rask Show Abstract An innovative, coherent, cw lidar has been developed that allows path resolved measurements of the received intensity from a continuous wave laser beam backscattered from atmospheric aerosols. The use of a cw transmitter allows for a relatively simple and compact system and minimizes problems with frequency stability of the source. In order to achieve path resolved measurements, the cw laser transmitter is optically, di-phase modulated with a pseudo random code. This allows, with proper signal processing, for separation of the signals created by light scattered from different parts of the path. The range resolution that can be achieved is controlled by the basic pulse width of the pseudo random code and can easily be changed. The current system has a meter full width-half maximum range bin size. The current system can work out to about meters and needs only milliseconds of data. Potential applications include optical remote sensing of winds, turbulence, chemical species using DIAL and perhaps temperature and pressure. Pirogov ; German M. The method is based on millimeter wave transmission along the path between two satellites, one carrying a transmitter, the other one carrying a receiver. In comparison with well-known radiometry, the method is distinguished by its particular precision and resolution. Kieu; Roger Dickey Show Abstract The complement of meteorological sensors on-board the DMSP satellite F11, launched in November , included the first passive microwave atmospheric moisture sounder system. Sounding channels include three symmetrically-placed acquisition channels on the A confirming study was conducted by Aerojet Electronic Systems, builder of the moisture sounding system. Generally, the sounder performance was found to be good, with the exception of a number of cases of anomalously large disagreement with the RAOB ground truth. Average performance statistics for the moisture sounder are presented along with results of anomaly analysis. Suggestions for improving the verification procedures and for using validation disagreements to improve forecasts are offered. This anomaly left the moisture sounder software inoperable, but with several options available for restoring it to operability, albeit with degraded performance. The built-in flexibility of the ground processing software to accommodate this type of anomaly reduced both lost data and repair time. In this paper we describe the on-orbit performance of the repaired moisture sounding system compared with pre-failure performance, and with expected performance. The salient facts of the hardware failure and options for ground software fixes are also described. Narayanaswamy; Sapna George; K. The seasonal latitudinal and longitudinal changes in the radiance also need to be monitored for understanding atmospheric dynamics. The ESRM is described in this paper. Qingyou Chen Show Abstract In this paper we give the experiments for the measurement of EBI of an image intensifier with the change of temperature gradient of it. At the same time, we give the curves of EBI versus the different temperature gradients. We show the causes for EBI of an image intensifier with the change of temperature gradient. We conclude, from the calculations and experiments, that there is need for the waiting

measurement time for us to minimize the measuremental difference of EBI caused by temperature gradient. The paper provides some scientific basis for improving the objective performance of low light level night vision system in the field. We regard the system which statistical behavior is described by a set of Hamiltonians by two Hamiltonians in the simplest case. Similar multi-Hamiltonian models are known, for example. Such results permit us to suggest multi-Hamiltonians models to describe the effects of random media rain, clouds and turbulence in the Wave Propagation problems. Thus the problem of radiative transfer as a whole has cylindrical symmetry. We suggest approximation of such kind for radiative transfer problem with cylindrical symmetry. It might be used as a second iteration for the plane approximation for the secondary sources. The simplest case with isotropic conservative scattering near the terminator is presented as example. Gavrilovich Show Abstract A procedure for modeling the transfer of polarized radiation in the spherical atmosphere was laid down. Angular and temporal distributions of the Stokes vector parameters, extent and azimuth of scattered radiation polarization at variations of optico- geometrical parameters of the model have been obtained. Gavrilovich Show Abstract The computer-controlled polarimetric system for remote optical sensing of natural environment under sunlight or pulse illumination is described. The control of spectral-temporal parameters and receiving aperture allows the videospectropolarimetric distributions of scattered light to be constructed to serve as a source of overall information on optical and structural characteristics of objects studied. Mill Show Abstract The planned mid-course space experiment MSX observations will include two experiments for remote detection of atmospheric trace constituents above 10 km altitude, based on measurements of limb spectral radiance by the cryogenic IR interferometer and the ultraviolet and visible spectrographic imagers. The timing of the measurements is particularly advantageous since they will likely be the only regular limb observations of trace constituents during the operational lifetime of the MSX satellite. The SPIRIT III interferometer has a maximum spectral resolution of 1 cm-1 in six spectrally isolated channels whose vertical fields of view are between 4 and 13 km in line-of-sight tangent altitude. The six channels will provide spectra over wavelengths in the 2. The capabilities of the interferometer for the planned remote-sensing experiments, based on predicted instrument noise and saturation levels, are described in this paper. The radiative properties for eight types of water clouds are also studied. It is shown that the single scattering and multiple scattering properties of clouds depend strongly on the cloud macro- and micro- physics, and wavelengths. The analysis of brightness temperatures BT indicate that measurements of BT at 2. Furthermore, a technique for detecting clear skies and cirrus clouds is developed by analyzing the BT difference in both IR windows, i. Lentz ; Alfred W. Regush Show Abstract Realistic inversions of lidar signals for extinction using the Klett technique must take into account both the theoretical limitations of the inversion and the experimental constraints of the hardware. A simple test of the Klett inversion algorithm s19 is performed with and without experimental limitations and uncertainties. The effect of limited accuracy in the digitization of the lidar return and limited dynamic range is presented. A simplified technique for detecting clouds in the presence of low visiblity is developed, and some limitations are presented. Moira Hilton ; Alan H. Lettington ; Ian M. Mills Show Abstract Techniques for obtaining quantitative values of the temperatures and concentrations of remote hot gaseous effluents from their measured passive emission spectra have been examined in laboratory experiments. The high sensitivity of the spectrometer in the vicinity of the cm-1 band head region of CO2 has allowed the gas temperature to be calculated from the relative intensity of the observed rotational lines. The spatial distribution of the CO2 in a methane flame has been reconstructed tomographically using a matrix inversion technique. The spectrometer has been calibrated against a black body source at different temperatures and a self absorption correction has been applied to the data avoiding the need to measure the transmission directly. Reconstruction artifacts have been reduced by applying a smoothing routine to the inversion matrix. Krajewski Show Abstract A 3D multiparameter radar simulation procedure for rainfall studies is described. The procedure begins with the simulated 3D fields based on the COHMEX experiment and a mesoscale meteorological model of convective storm. Given the 3D rainfall fields, the sampling volume integration process involved in radar measurements is simulated to give radar

observables, namely, reflectivity, differential reflectivity and differential phase shift. Numerous effects are accounted for including: As a final step, the radar observables are corrupted with a random measurement error to account for the radar hardware system noise and other sources of uncertainty. The simulated radar observables are qualitatively assessed. The simulator is a useful tool for engineers and hydrometeorologists who are interested in examining radar measurement errors and their effect on other variables of interest. Smith Show Abstract Satellite-sensor based microwave brightness temperatures are compared with radar based reflectivities for a three-dimensional mining cloud. The brightness temperatures are computed using a radiative transfer model based on the discrete-ordinates method. The synthetic reflectivities are generated from a three-dimensional physically based radar simulation. Comparisons between the brightness temperature and reflectivity fields at matched resolutions appear to be well correlated and may indicate that reflectivity measurements could be combined with brightness temperature observations in order to estimate rainrates. Results of a simulation examining the relationship between surface rainfall rate, reflectivity, and brightness temperature measurements are reported. The stochastic framework of this study allows the variance of remotely sensed quantities to be described in terms of variations that might occur in realistic precipitation events, and provides a framework for calibrating satellite-based rainfall estimation methods using radar measured refiectivities. Lundberg Show Abstract In this paper, we present the first of a two part discussion to improve the specification of atmospheric transmission calculations using a new methodology to reduce the uncertainty in pixel-level temperature profiles derived from meteorological satellite sounder data. Temperature profiles are examined first, since these data are used to derive the moisture content of the atmosphere. Our results show that the uncertainty in the specification of temperature profiles, for pixel level retrievals of meteorological satellite sounder data, can be assessed using knowledge on the accuracy of the initial-guess to a physical relaxation algorithm. First, a simple transfer model of short wave radiation is established, then the criterion of channel selection for a general remote sounding equation is introduced. The channel for sounding an aerosol parameter is selected according to the degree of predominance DP of this parameter. After that, the DPs of various aerosol parameters are analyzed. The results show 1 it may be difficult to sound total aerosol number, aerosol size distribution parameters and aerosol complex refractive index simultaneously, 2 selecting channel in 0. Pei-Yuan Xu Show Abstract A compact four-channel microwave scanning radiometer for tropospheric remote sensing is being developed. A pair of For each pair of frequencies it has an offset reflector antenna and a Dicke-switching receiver. The pair of receivers is assembled in an enclosure, which is mounted on the rotating table of an azimuth mounting and the pair of antennas is connected with the rotating table of an azimuth mounting in the opposite side by a pair of elevation arms. Each antenna is composed of a 90 degree off-set paraboloid and a conical corrugated horn. The dual band humidity receiver is a time sharing type with 0. The dual band temperature receiver is a band sharing type with 0. The radiometer and observation are controlled by a single chip microcomputer to realize the unattended operation. The current design takes advantage of advanced RF and digital signal processing technologies to produce an instrument that is both light-weight and reliable. Analysis of the range, waveheight, and backscattering cross section performance indicates that the GFO altimeter will achieve equivalent GEOSAT performance in all areas. Porter ; Anthony D.

Chapter 3 : Atmospheric Propagation and Remote Sensing III | () | Publications | Spie

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The basic quantities computed by the band models are individual species spectral transmittances through homogeneous path segments. These segments are defined within single atmospheric layers if the Correlated-k CK [see: The individual species transmittances are themselves computed as a product of three terms: This invention features a band model method for computing individual atomic and molecular species spectral transmittances through a gaseous medium, comprising: The spectral bins may have a width of about 0. The calculating step may include an exact expansion for calculating the bin Voigt equivalent width of atomic and molecular transitions whose centers lie within each spectral bin. The exact expansion is preferably an exact modified Bessel functions expansion. The calculating step may include subtracting the line-tail absorption as calculated from the column strength, the Lorentz half-width, the Doppler half-width, and the line tail spectral displacement. The calculating step may include determining the Voigt line-shape function at specific spectral frequencies. Another embodiment of the invention features a band model method for determining the contribution of line centers to the computation of individual atomic and molecular species spectral transmittances through a gaseous medium, comprising: Yet another embodiment features a method for determining the contribution of line tails to the computation of individual atomic and molecular species spectral transmittances through a gaseous medium, comprising: LBL models calculate high spectral resolution absorption solid curve. Band models statistically determine the average integrated strength dash line based on line strength, line density, and line width parameters. The spectral curves from largest contributors are also illustrated lines with diamond for lower frequency transitions and lines with squares for higher frequency transitions. The lower curve is the residual between the upper curves. Results are illustrated for line center optical depths of 0. The thick curves with symbols are the results from the modified Bessel function expansion truncated at I6, and the thin curves without symbols are the results computed assuming line tails are inversely proportional to frequency squared. Results are illustrated for bandwidths of 6. The modified Bessel function expansions truncated at I5 and I7, and a simple weak-line to strong-line interpolation formula is compared the exact result. Note the curves have been plotted with a break in the ordinate scale at 0. The results are illustrated for the entire 4. As is common in band model theory, an effective average line is defined for calculation of the line center absorption. The finite bin equivalent width of that line is computed with the line centered one-quarter of a bin-width from one bin edge and three-quarters of a bin-width from the other edge. New algorithms described below are required to accurately and efficiently compute the finite-bin equivalent width for bin-widths of size comparable to the line width. In the line tail computations, lines centered too close to a spectral bin edge, i. On average, half the lines contributing to the interval are centered in the interval and half are centered outside the interval. Thus, the finite-bin equivalent width is computed for a line centered precisely on the edge of the spectral bin. This simplifies the line center calculation because only a single line tail must be computed, and, more importantly, the line tail begins a full bin-width from line center instead of at the quarter of a bin-width point. Thus, the position of line centers does not have to be translated to avoid modeling line centers as line tails. The consequence of this incorrect partitioning is that the resolution of the band model is reduced. Of course, the bin-width in the double-bin method could be reduced to 0. Since atmospheric molecular line half-widths can be as large as 0. A description of the upgraded algorithm for line tail absorption follows. Line tail spectral absorption cannot be modeled as constant or even Lorentzian so close to line center.

Chapter 4 : atmospheric propagation and remote sensing ii | Download eBook pdf, epub, tuebl, mobi

remote sensing applications Steven A. Cummer and William M. Farrell Laboratory for Extraterrestrial Physics, NASA Goddard Space Flight Center, Greenbelt.

Chapter 5 : Infrasound monitoring for atmospheric studies [electronic resource] in SearchWorks catalog

The characterization of the water vapor continuum remains an important problem concerning infrared propagation in the atmosphere. Radiometric imaging within the atmosphere in the 8 to 12 micrometers and 3 - 5 micrometers regions, and eye safe lidar in the 2 micrometers and micrometers window regions require accurate knowledge of the water vapor continuum.

Chapter 6 : OSA | Temporal averaging of turbulence-induced uncertainties on coherent power measureme

Atmospheric optical turbulence (AOT) degrades seeing conditions over long horizontal paths. Embedded into the typical AOT diurnal cycle are two time periods in which the AOT is at a minimum; these periods are called neutral events (NE).