Review Paper on "Extraction of Information from Droplet Analysis using Signal Processing"

Mr. Pandharinath A Ghonge[1], Dr. Kushal R Tuckley[1]
[1]Electronics Engg. Department, Ramrao Adik Institue Technology
Nerul Navi, Mumbai, India

Abstract **-** The 2D-Video-Distrometer is a newly developed precipitation gauge, working on the basis of high defined video cameras. 2D Video-Distrometer is designed to meet the needs generally of anybody interested in details on precipitation. The rain consists of patches of elementary drop size distributions over a range of different scales. All measured drop size distributions that the interpretation of the measured distribution depends upon whether the rain is *statistically homogeneous* or not. It is argued and demonstrated using Monte Carlo simulations that in *statistically homoge-neous* rain, as the number of patch included increases; the observed spectrum of drop sizes approaches a "steady distribution. In contrast, steady distributions in statistically homogeneous rain are more amenable to deterministic interpretations since they depend upon factors independent of the measurement process. A snowflake is an aggregation of ice crystals. A non-aggregated snowflake often exhibits six fold radial sis fold radial symmetry. The distrometer is an instrument to measure the size, shape, velocity and precipitation of particles

Keywords – *2D-Video-Distrometer, Patches, Snowflake.*

I. INTRODUCTION

Knowledge on details of rainfall is of vital importance in meteorology, in the fields of signal processing, Various types of distrometers measure different parameters some of the interesting parameters and in many cases some have to be set to predefined values,. In this situation the idea of a new develop instrument has come up, the new instrument should measure all the relevant parameters and identify nature of rain. Now, The meaning of a drop size distribution is one of vital part[1] In the past, the measurement of drop sizes was a straightforward albeit very laborious task involving sifting raindrop pellets. By involving several studies to collect an impressive array of data in several straits form rain events of different intensities. The frequency distribution of drop sizes (diameters, volumes) that is characteristic of a given fall of rain. In convective clouds, the drop-size distribution is found to change with time and to vary systematically with height, the modal size increasing and the number decreasing with height [2] For many purposes a useful single parameter representing a given distribution is the volume median diameter, that is, that diameter for which the total volume of all drops having greater diameters is just equal to the total volume of all drops having smaller diameters. The drop- size distribution is one of the primary factors involved in determining the reflectivity of any fall of precipitation ***2D-Video-Distrometer*** Originated in the area of weather radar and propagation research, the 2D-Video-Distrometer is now suited for all kinds of applications where details on precipitation are of interest [3]

II. DROP DISTRIBUTION

The meaning of a drop size distribution is one of the important parameter parameters that correlated with the rainfall rate, *R* . . Experiments [1] in which water was released to fall over long distances thereby allowing the distribution to evolve through drop breakup. While cumbersome and incomplete, since the water could never fall a distance sufficient for the drops to achieve "equilibrium," such experiments were a convincing demonstration that the size distributions did indeed approximately evolve through drop breakup and coalescence toward those observed in nature. Moreover, the most advanced techniques combine different measurements using different instruments each having its own "beam width" so that, in effect, they are looking at different ensembles of rain patches, that is, at different total drop size distributions

The required sufficient samples can be defined In order to see how the net distribution changes with increasing sampling (volume), these samples are then combined one by one and the resulting fraction of the total number of observed drops is calculated and plotted for the different drop sizes [1] In spite of increases in the total volume sampled, at no time do the contributions at any of the sizes become "steady." At first with increasing distance the maxi-mum in the fractional contribution peaks at increasing sizes (solid line). The contributions from the larger drops then decrease while at still greater distances (sampling path lengths) there is a subsequent resurgence in the fractional contributions at the smaller sizes to the right of the dashed line*.This can be seen as well by looking at some selected size distributions [1,2]

III. SAMPLE THRESHOLD

A Poisson process is characterized by three assumptions that the probability of detecting more than one drop in a given volume that drop counts in nonoverlapping volumes are statistically independent random variables (at any length scale) that process is statistically homogeneous. With regard to rain, the first point can usually be satisfied. The second assumption, however, is usually found not to be true for single size bins [1,4] nor for several size bins either[4] That is the presence of a drop enhances the likelihoods that there are other drops of the same or different size in the neighboring volume. In other words, the drop counts in neighboring volumes are correlated. Such correlations do not exist for a Poisson process since counts in all neighboring volumes at all separations are statistically independent. Thus, natural rain cannot normally be described using Poisson statistics.

The correlations in natural rain arise because rain appears to consist of "patches" of different dimensions. That is, there are locations rich in drops interspersed with regions where drops are scarcer [5] Before we explore the nature of these patches below, let us first return once more to the discussion of Poisson statistics. Assumption third means that Poisson statistics can never apply in statistically inhomogeneous conditions that likely often exist in nature. As we will see, however the entire topic of statistical homogeneity is subtle and has implications for the meaning of drop size distributions well beyond concerns about Poisson statistics. This contrasts sharply with random variables obeying a statistically homogeneous Poisson process having no correlation in which *every* single sample corresponding to the smallest observation volume is independent so that the convergence is quite rapid. The logical opposite of statistical homogeneity is *statistical inhomogeneity* in which the expected value and, in its broader sense, the variance of R change from location to location within the observation volume. Statistically inhomogeneous rain is also patchy as well [6] When the drops in patches are combined, they add up differently depending upon whether the rain is statistically homogeneous or inhomogeneous. Statistically homogeneous rain by definition means that the rainfall rate, R, is statistically homogeneous; that is, expected value of R, $E(R)$, and the variance,var(R), remain constant with regard to shifts in the origin. But since R is the sum of the number of drops over each of the different sizes times their mass times their terminal fall speeds, the statistical homogeneity of R implies that the expected number of drops homogeneous rain, the measured distributions approach the overall, steady distribution as more and more patches are combined. Since such distributions exist independently of the measurement process, they have intrinsic and presumably deterministic meanings. In statistically inhomogeneous rain, however, the drop size distributions continually change as more and more data are added so that final drop size distributions depend upon where one stops[6,7]. Thus unlike drop size distribution in statistically homogeneous rain, the distribution in statistically inhomogeneous rain depends critically upon the measurement process. Consequently, such distributions are statistical mixtures of several elementary drop size distributions and they represent "mean conditions." deterministic meanings as the addition of more data. In a real sense, the most basic or elementary drop size distributions that can be observed are of those found in patches. However, sometimes it is really more useful to have "representative" distributions over larger dimensions. In statistically homogeneous rain this is easy since the more one measures, the more one converges to the overall measurement process. In statistically inhomogeneous rain, however, the drop size distributions should be viewed as steady distribution that exists outside the statistical mixtures or, alternatively, as distributions of mean concentrations that depend critically upon where and how the measurements were made.[8].Obviously an important characteristic of rain is whether or not it is statistically hogeneous yet, determining this characteristic is not trivial. One promising approach may be to use the observation that in statistically homogeneous rain, since the drop size distribution is steady, averages of powers of the diameter (so-called zero moments of the size distribution) are linearly related [8,9] Consequently, one expedient approach for identifying statistically homogeneous rain may be to use scatter plots[9] along the lines Where such near linearity exists, there is at least a chance that the data may be statistically homogeneous[9].

IV. DIFFERENT RAIN NATURE

In warmer clouds an aerosol particle or "ice nucleus" must be present in the droplet to act as a nucleus. The particles that make ice nuclei are very rare compared to nuclei upon which liquid cloud droplets form; however, it is not understood what makes them efficient. Clays, desert dust and biological particles may be effective, although to what extent is unclear. Artificial nuclei include particles and these are used to stimulate precipitation [10].Once a droplet has frozen, it grows in the supersaturated environment, which is one where air is saturated with respect to ice when the temperature is below the freezing point. The droplet then grows by deposition of water molecules in the air (vapor) onto the ice crystal surface where they are collected. Because water droplets are so much more numerous than the ice crystals due to their sheer abundance, the crystals are able to grow to hundreds of millimeters in size at the expense of the water droplets. The initial symmetry can occur [10] because the crystalline structure of ice is six-fold. The six "arms" of the snowflake, or dendrites then grow independently, and each side of each arm grows independently. Most snowflakes are not completely symmetric of each single hydrometeor reaching the measuring area the front- and the side view and the vertical fall velocity are measured and recorded. Finally snow data shall be presented. [11] Clearly indicates, that snowflakes of any size are hardly faster than 2 m/s in fall velocity.

Snowflakes present totally irregular shapes to the camera,[12] give an example. Such data provide detailed information and allow unprecedented investigations on snowfall, its interaction with electromagnetic waves and also of growth and structure of the snow.

V. CONCLUSION

The 2D-Video-Distrometerreveals comprehensive set of details on hydrometeors. Results allow an insight into precipitation leading to a better understanding of situations. Further studies investigate the influence of environmental conditions on the measured precipitation parameters as well. Special attention will be drawn to the drop size distribution to declared nature of rain. In the field of wave propagation the measurements of the 2D-Video-Distrometer are a well defined basis for the prediction of interaction between electromagnetic waves and precipitation Snowflakes present totally irregular shapes to the camera. Such data provide detailed information and allow unprecedented investigations on snowfall

VI. ACKNOWLEDGMENT

I would like to thanks Ramrao Adik Institute of Technology for providing necessity facilities and University of Mumbai for funding under the Minor Research Grant.

VII. REFERENCES

[1] A R Jomeson, A.B Konstinski, "What is a Raindrop Size Distribution", RJH Scientific, Inc., Alexandria, Virginia Department of Physics, Michigan Technological University Houghton, Michigan 23 January 2001.

[2] Blanchard A.C.and A.T.specer 1970 Experiment on the generation Rain drop size distribution.by drop brake-up J Atioms, sci 27.101-108

[3] N.Bringi, V.Chandrasekar, J.Hubbert, E.Gorgucci, W.L.Randeu and M. Schoenhuber, "Raindrop size distribution in different climatic regimes from disdrometer and dual-polarized radar analysis," J. Atmos Sci., vol. 60, no.2, pp.354–365, Jan.2003

[4] Feller W, An Introduction to Probability Theory and Its Application Vol. 2, John Wiley and Son, 1982

[5] On the spatial distribution of cloud particles, Atmos. Sci., 57, 901–915.

[6] R., D. Hudak, R. Nissen, N. P. Tung, S. K. Soo, and T. S. Kang, 1988: Raindrop size distributions in warm rain at Penang, Tropical Rainfall Measurements, J. S. Theon and Fugono, Eds., Deepak Publishing, 271–278.

[7] Ochi, M., 1990: Applied Probability and Stochastic Processes.John Wiley and Sons, 499 pp.

[8] Shappared B E and P I Joie 1994 Comparison rain drop size distribution measurements by Joss-waldvogel distrometer

[9] P. L. Smith and D. V. Kliche, "The bias in moment estimators for parameters of drop size distribution functions Sampling from the exponential distributions,"J.Appl. Meteorol., vol. 44, no.8, pp.1195–1205, Aug.2005

[10] A. J. Illing worth and T.M. Blackman, "The need to represent rain drop size spectra as normalized gamma distributions for the interpretation of polar-.Appl.Meteorol., vol. 41, no.3, pp.286–297, Mar.2002.

[11] M. Klesius (2007). "The Mystery of Snowflakes". National Geographic 211 (1): 20. ISSN 0027-9358.

[12] Bohannon, Johnruehe T. "Science Shot: The True shape of Snowflakes" Science NOW. American Association for Advancement of Science Retrieved 12 April 2013