

Tapered Antenna Beam with Cosmological Far-off Retrieval on Fracto-Sun Signatures and Surfaces Gaits Approachability

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Abstract—Space Sensing Models promulgate the channeling sequels of interstellar environs. A fractal array with sun-shaped irregular molds has arisen to solar activities by interchangeably pointing in the direction of sun and off source with beam swapping, whilst weighing the sun’s position (psi, phi)-space (phi demarcates the antenna azimuth proportionate to north, psi contours the beam elevation over horizon) and its solid radioactivity hoarded in the antenna’s beam width. The research feedback has incidents of solar fluxes and brightness temperatures to depict sun’s activity. Phenomenally, nature-space fractals have been quintessence in intuiting sun’s aftermath pertaining to weather and biological sways $\{\text{Weierstrass } C(x, y)\}$ on landscape, swirling with fractal clock underpinning magnetic flipping and irradiance fluctuations at phase vicissitudes have periodically wedged on territory. The remote alliance algorithms with random fractal contours have subsidized paths of self-affine topographic surfaces and space-earth stoichiometry. In this paper, antenna solar scan corollaries at X-band to detect the solar activity on fractal boresight physiognomies of 3-dB HPBW around 0.5° solar diameter with 36° crest atmospheric stray radiations (SLL) rope in petite sidelobes 60° near the core flamboyant region, return loss $S_{11} < -10$ dB at X/Ku-band on horizontal and vertical tilting bearings have been estimated.

1. INTRODUCTION

Enduring to solar dynamics events, Space Weather syndrome correlates to the ionospheric demeanor on sun’s prodigies [1]. The space-weather outrage includes geomagnetic bursts, solar flares, Coronal Mass Ejections (CMEs) [2], and radio blackouts in the polar regions. The anomalies of solar radio bursts surround electronic “upsets”, electrostatic discharges (ESD), GPS satellite receiver’s outage, phantom commands of on-board spacecraft and aviation control, electric power grids and radio hazards at auroral latitudes [3–5]. In actuality, congregation of ionospheric electron density subsists the sequel of solar flares (eruptions of X-rays and EUV flux) in the upper atmosphere [5], and abrupt eruptions may be prolonged from a few minutes to several hours. Space-geodetic techniques such as Satellite Laser Ranging (SLR) and Very Long Baseline Interferometry (VLBI) generate global and regional crustal dynamics and earth rotation parameters [6]. Nowadays, Global Navigation Satellite Systems-Reflectometry (GNSS-R) exercises navigational acquiescent signals to the surface delivers [7]. With nadir cruising of satellite altimetry and water gauges, c GNSS-R altimetry creates off-nadir weights on zenith-pointing antenna; telling-off on the Qinghe Arch bridge at East Lake, Wuhan, China and 1-cm precision water measurements attained by GNSS L1 and L2 carrier-phases upshots. The logging of space-based ionospheric tidings and ground-based GNSS surveillance statistics has commendably enriched the precision and fidelity of Global Ionospheric Maps (GIM) in sea belts by *vertical* TEC (VTEC) evidences via ocean altimetry satellite and Constellation Observation System for Meteorology, Ionosphere and Climate (COSMIC) occultation especially in the Southern Hemisphere near the Antarctic region [8].

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The astral influence probed by Chinese Feng-Yun 3C GNOS Satellite (Retrieved with Radio Occultation at Mohe, Beijing, Wuhan and Sanya) [9], Electron Density Profiles exhibiting NmF2 and hmF2 with higher correlation coefficient in the middle-high latitude compared to lower latitude region is due to the ionospheric horizontal inhomogeneity. The space weather-antenna affair has been bequeathed in GNSS-R Space borne UK TDS-1 mission [10] with antenna peculiarities as slight off-pointing 6° down-tilted away from flight, and SGR-ReSI nadir antenna's precision relies on gain map and cognizance about Spacecraft Altitude. Specular points outside antenna main beam and small altitude errors can lead to large inaccuracies in the geophysical inversion. With antenna array modelling, multi-frequency GNSS-derived TEC solution [11] assimilated symptom Ionospheric Estimable parameters. The research autopsy [12] at BAKE and KUUI GPS stations in Northern Canada witnessed snow accumulation and melting variations amidst bare soil and fixed snow depth commend from reflected-sourcing GPS signals with antenna gains and multipath signal. The canvass behind exploration of space-electromagnetic fusion to assimilate radio observations with precise antenna modeling by remote-sensed pervasiveness has been transfixed over the years.

The meditation of the fractal electrodynamics is well addressed in depicting weather echoes (red sprites) [13] and solar gravitas [14]. On the space-age antenna evolutionary, fractal electrodynamics in an efficacious genre for the design of satellite gratings on broadband CP Spidron Fractal Slot antenna arrays in Ku-band [15], 18 GHz defected ground structure (DGS) Fractal Apollonius Array [16], Miniscule $120\lambda \times 120\lambda$ mass of hybrid fractal direct radiating arrays (DRAs) antenna with prodigious performance in camaraderie of the maximum $D_{\max} > 45$ dBi and end of coverage (EOC) directivity $D_{\text{EOC}} > 43$ dBi, low side lobe level $\text{SLL} < -20$ dB, suppressed grating lobes and control driving points with competent feeding network by multibeam antenna arrays [17] and earth-observation project on Tigris at -7.3 dBi S-band antenna with Wilkinson dividers during the mission of dust storms detection [18] over Iraq were propelled on June 19, 2014 from the Yasni cosmodrome in Russia.

Persistently, articulating and disentangling the patterns and geometrical signatures whirls out to conceive the interaction between backscattered signals and surface ownership. The Probabilistic Scattering Model from a Gaussian distributed random surface with electromagnetic demeanor such as the average and variance of the scattered electric field, incoherent scattering intensity and cross section per unit area has been scanned [19]. The climatological radar model with BIOMASS P-band SAR impacts to disseminate WBMOD scintillations of forest biomass and tree height under high sunspot activity-northern tree line ($\sim 70^\circ$ geomagnetic) over the streaming solar and geophysical states has been surveyed [20].

In recent years, terrain-ambient sensing on micro-fabricated and mm-wave insignias with exceptionally integrated-planar architectures prompt new modeling approaches and prospects to radio-coax-operators. The system and transistor-level design of W-band active mm-wave reflectors with one receive/two transmit channels sustaining 55-nm SiGe BiCMOS tag {25/10.8-mW (active/idle)} has wake-up sensitivity level of -62 dBm, power saving mode in case of interrogation absence from the FMCW radar base station on chip-fabricated [21]. Three fundamental- and two second-harmonic, ultra-low power multireceiver 45-nm SOI CMOS transceivers for V-band radar were concocted with single-chip sensor architecture [22].

Furthermore, radio-cosmos patronages space and terrestrial feelers delivery; interplanetary post-event analysis related to the phase fluctuations of radio signals near ground surfaces. Subsequently, stochastic modeling and techniques have been enthralled to gratify constraints of radio propagation and sensing with subservient outcomes. In this deem, space electromagnetic compatibility includes remote modeling tradeoffs for near and far surfaces, channel anisotropy and thickness, angular polarization sequels, humidity diktats, and multi-scale surface roughness [23–26]. It has been aimed at the research of the self-semblance patterns and fractal draughts of the antenna solar scan sequels with acquaintance of climatology to radiate broad array of propagation modes. In the repercussion, dualistic approaches have been chartered to catalog surface asymmetry chattels and solar radiative (fluxes) with fractal geometry through sun sublayer's diversification and segmentation explicating on antenna modeling, owing to their scale invariance, twisting and transformation.

2. FRACTAL AFFINITY AND FAR-FLUNG EVINCES OVER IRREGULAR SURFACES

On space-electromagnetic-sequel, sporadic microwave from the target by reflector antenna causes interference with inhomogeneous conduct of landscape and fragmented surroundings, i.e., target's radiative canopy shillyshallies with swarm texture of nature [3, 25, 27, 28]. With low ratios of signal contextual, natural patterns hypothesis infers spatial properties of the earth's masking regional images with homogenous statistical species in the vicinity [24, 29]. The countless nature contours such as galactic clusters, snowflakes, lightning, stars, flora, coastlines, and mountains reveal fractal signatures to unscramble futuristic radio-electronics design challenges [30]. The Geological Statures from Landsat Spacecraft extricates the chronicle of the earth's landmass surfaces — an evolving long term program exploring vicissitudes on terrain's global environment at Fig. 1, metaphors observatory. The atmospheric phenomenon endures a symmetrical and scale invariance pursuit in which the small and large scaling statistics have been interrelated by a differential stratification (gravitational) and differential revolution (owing to the Coriolis forces) [31, 32].

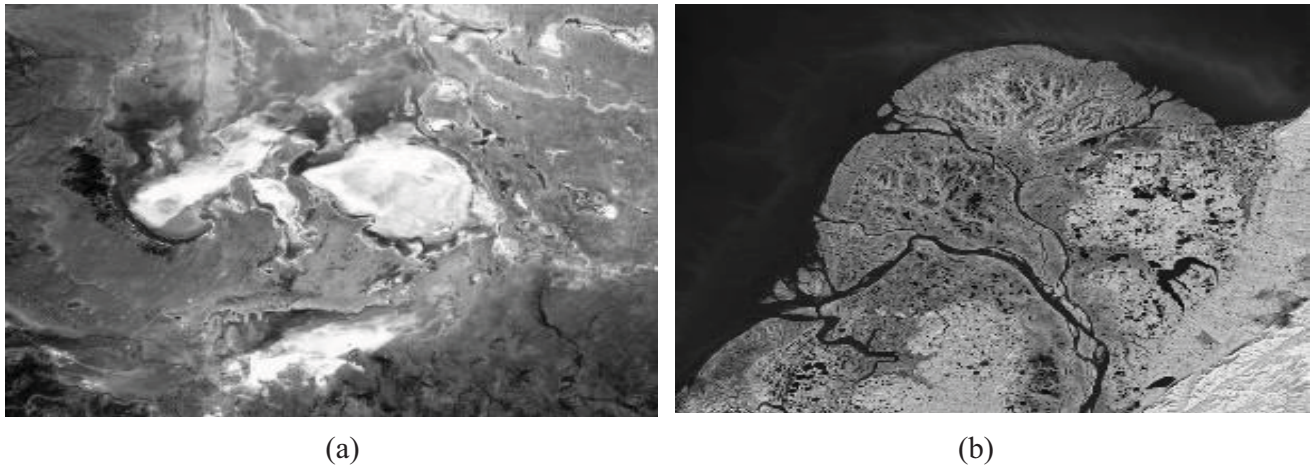


Figure 1. Irregular surfaces topographies: (a) Inundated patches of shallow Lake Eyre, Australia with flat, parched landscape, (b) Yukon Delta in South West Alaska river's sinuous water ways as blood vessels branching out to cuddle an organ. *(Courtesy@NASA's Goddard Space Flight Center/USGS, LANDSAT Earth Observation Satellite).*

According to surface roughness proclaims, radar remote sensing disseminates vital data of events about topography and self-affine (fractal) dynamics of planetary surfaces [33, 34]. To estimate the ice-drift velocity vector in a region (2015 Svalbard North operation) around a free-floating and progressing vessel, Radar Image processing with two Kalman filters has been affirmed [35].

With a gamut of random verdicts to nature-inspired fractal geometries such as Veins Network of the *Populus tremuloides* leaf on electrochemically deposited to purchase signatures of random fractal appendages [36], pattern rejuvenation to exclusively ordered (periodic) and disordered (random) with side lobe level reduction on fractal quasi-random arrays [30], branching multiband structure of self-symmetric radiating dipoles randomly dispersed in space, and every branch of the tree antenna resonated at wavelength four times its length under electrochemically-deposited 3-D Random Fractal Tree-Monopole skeleton experimented [37]. An ultra-wide FBW 175%, high-quality fidelity factor ($> 90\%$) by Chebyshev and Exponential Tapering [38] on Fern Fractal Leaf inspired Antipodal Vivaldi Antenna (AVA) to exhibit compact shades of nature fractals for Microwave Imaging System is fulfilled recently. At radio-feelers-topographies underneath nature fractal surfaces, Q_o elements take J recursive surface signature (RCS, ε permittivity):

$$Q(\varepsilon) \approx 1/\varepsilon^J, \quad \varepsilon \rightarrow 0 \quad (1)$$

According to recursive surfaces signature J , surface entails incidence degrees of irregularities vis-à-vis backscattered echoes by the earth's surface scattered wavelength. It implies that spectral wavelength reliant on surface roughness obscured from radar scattering stays consistent with self-affine topography (Hurst exponent, $(0 < H < 1)$) [33], supervenes to planetary surfaces elucidations [39]. Several rough surface models as small perturbation (SPM) [33, 40], fractal and classical surfaces on Kirchhoff approximation (KA) scattering pertinent to the fractional Brownian motion (fBm) conveys proportionality to the probability density function (pdf) of the symmetric alpha-stable ($S\alpha S$) 2-D random variable over surface slopes and chases to the remote sensing and geometrical optics (GO) [41]. In ordering of electromagnetic scattering from fractal chaotic surfaces, surface signature J on backscattering cross section shares:

$$J \approx \frac{\ln \rho_2^2 - \ln \rho_1^2}{\ln \beta_2 - \ln \beta_1} \quad (2)$$

while ρ_1, ρ_2 and β_1, β_2 stay root mean squares of the primary and secondary fractal-fragment strengths discretely. The fractal scattering coefficients depict rough surface height profile as stationary with statistically inhomogeneous surfaces amid fBm process [42]. Wide-ranging spectral models of terrain chaos also confess the remote intuiting wave interactions with complex façades in terms of clutter echoes (sea, rain, sun, chaff and atmospheric syndromes) to subsidize vigorous paths of radar signal reconstruction. The electromagnetic scattering by 2D rough surfaces bordering larger heights and slopes over layered snow and subsurface-snow layer with smaller permittivity at Sastrugi Surface in polar regions, occasioned on multi-layered radiative transfer (RT) equations by Method of Moment (MOM) solutions [27].

The classical optics propagation with electromagnetic waves affiliated to band-limited Weierstrass fractals [43] amidst diffraction of plane waves by fractal phase screens in the fourier-optics approximation thru Fraunhofer and Fresnel computations simultaneously. The band-limited Weierstrass function with surface roughness [23, 24, 44–46] scattering through variant fractals:

$$C(x, y) = g_v \sum_{q=0}^{Q-1} s^{(J-3)q} \sum_{r=1}^R \sin \left\{ K s^q \left[x \cdot \cos \left(\frac{2r}{R} \right) + y \cdot \sin \left(\frac{2r}{R} \right) \right] + \psi_{qr} \right\} \quad (3)$$

while $C(x, y)$ prevails to be anisotropic if Q and R abide slenderer ranges, multi-dimensional surface and roughness being scaling-dependent to interpret natural surfaces. With the parameters in Eq. (3), band-limited Weierstrass function countersigns $C(x, y)$ with unit perturbation amplitude, whereas fundamental spatial frequency $s (s > 1)$, J epitomizes $(2 < J < 3)$; K means fundamental wave quantity; Q and R are the amount of tones; and ψ_{qr} denotes the phase with uniform distribution over the interval $[-\pi, \pi]$.

Parenthetically, band-limited fractals converge in the electromagnetic compatibility towards waves propagation through random media, reflectivity by irregular surfaces, surmised strings on remote sensing. At staring, pondering of Synthetic Aperture Radar (SAR) image modulation points out the direction and azimuth of the multifalse targets as precisely steered by the Phased-Switched Screen [47]. Fittingly, diffraction by band-limited fractal screens mandate the array conducts to practical-acquainted on underwater acoustics and duct propagation [43]. In the generation of Eq. (4), liaison between multi-layered fractals and radar [45, 48] hoards with average autocorrelation coefficient $\dot{\Gamma}(\tau)$ through order zero Bessel function $F_o(K s^q \tau)$ on s and J [46]:

$$\dot{\Gamma}(\tau) = \langle \sigma(\tau) \rangle_h = \left[\frac{(1 - s^{2(J-3)})}{(1 - s^{2(J-3)Q})} \right] \sum_{q=0}^{Q-1} s^{2(J-3)q} F_o(K s^q \tau) \quad (4)$$

As in the assent, average autocorrelation coefficient $\dot{\Gamma}(\tau)$ unveils its applicability with Kirchhoff approach on sea-surface modelling, enduring the exigency of fractal dynamics by fractional dimensions from the subarray fractal generation and angular field distribution to breed beam propagation in random media. In particular, nature tentacles on flourishing elucidation of fractal array textures with frequency-selective surfaces, multiband and wideband attributes, low-side lobe radiations, methodical layout to thinning, aptitude to stride rapid beamforming on recursive tactic and electrochemically deposited random fractal

tree-like antennas have been whittled [30]. The seminal inscriptions of fractal parameters on the contour of scattered field and average field intensity coefficient of scattering w [46] are:

$$w \approx \frac{E^2(\phi_1, \phi_2, \phi_3)}{\cos^2 \phi_1} \left[\left[1 - \frac{1}{2}(kD\rho)^2 \right] \text{sinc}^2(kAU_x) \text{sinc}^2(kBU_y) \right. \\ \left. + \frac{1}{4} D_e^2 \sum_{q=0}^{Q-1} \sum_{r=1}^R s^{2(J-3)q} \text{sinc}^2 \left[\left(kA + K s^q \cos \frac{2\pi \cdot r}{R} \right) U_x \right] \cdot \text{sinc}^2 \left[\left(kB + K s^q \sin \frac{2\pi \cdot r}{R} \right) U_y \right] \right] \quad (5)$$

On the field scattering of Eq. (5), multiscale fractal surfaces tunnel on stretches with surface roughness of optical and electromagnetic scattered wave amplitudes, optical and radio frequency characterization, and acoustical tomography on oceanic exploration. Empirical samples explicate wave scattering using intensity coefficients of patterns through corrugated surface, an anisotropic surface (meshing of sinusoidal grating and isotropic surface) and an isotropic surface, respectively. It can also be apropos to the taxonomy of rough surfaces and unravelling the inverse problem of heterogeneous surface reconstruction compelling from measured scattered field patterns. Analogously, brillouin diagram elucidated wave propagation in periodic media, and almost periodic media will be similar unless band gaps overlap with reflection coefficient phenomenon [49]. To judge the geometrical peculiarities using the remote sensing radars, surface parametrons must be modeled against the backscattering coefficient on each divergence [29, 39, 40].

The comprehension can be broadly immersed to discover topographies of squint observables to the scattering-sound anecdotal of the ocean acoustics, terrain and meteorological clutters, and multi-scale random surfaces. Thenceforth, fractals have been lucratively captured in Radio Engineering nexus multi-layered-antenna geometries, metamaterials, filters, and computing random surfaces signatures on wide-ranging of natural phenomenon. At the glimmering, orthodox wave propagation mélange and scattering by rough surfaces has been revamped due to environmental and space weather encounters globally.

3. ANTENNA-SPACE FADING AND SOLAR DISK PRODIGIES ON RADIO SOUNDINGS

The space-reliant communiqué has a stubborn delivering of deplorable mesh reflectors with contoured beam gain and effective surfaces, multiband and multi-pol feed assemblages, high power test means on nanotubes and EBG, tracking and multiple beam antennas (MBA) at K/Ka/Q/V-bands with low losses [50].

Many remote sensing technologies have been launched in planetary space [51, 52] to capture atmospheric footprints including antenna's noise temperature and brightness temperatures on minute scales indoors universe [53]. Fascinatingly, nature and space fractals orchestrate key paradigm in sensing Sun's aftermath pertaining to the weather and biotic effects on Earth, swirling with fractal weight on the spatial diffusions of the solar dynamics [14]. On the occasion of spacecraft in interplanetary, it is indispensable to consider brightness temperature owing to the presence of sun and the galaxy (the Milky Way) as a wide belt of cogent radiation. Subsequently, aircrafts were undetectable by Secondary Surveillance Radar (SSR), during times of intense solar flares transpired in November 2015 in Northern Europe, whilst being ill-equipped with SSR transponder due to dysfunctionality of over-interrogation [54].

In 2010, NASA's Solar Dynamics Observatory was launched to apprehend the Sun's weight on Earth and near-Earth space by probing solar atmosphere, i.e., energetic particles from flares, CMEs, and plasma turbulence from solar wind, captured in Fig. 3, after 3-years SDO lurching phase. Exploiting the sun's brightness temperatures at radio frequencies, cosmological-maneuvers on reverberation of antenna noise temperature T_N leads to convolution of the antenna power radiation $F_p(\psi_0, \phi_0, \psi, \phi)$ and sky brightness temperature $T_B(\psi, \phi)$ [55–57]:

$$T_N(\psi_0, \phi_0) = \frac{\int_{4\pi} T_B(\psi, \phi) F_p(\psi_0, \phi_0, \psi, \phi) d\gamma}{\int_{4\pi} F_p(\psi_0, \phi_0, \psi, \phi) d\gamma} \quad (6)$$

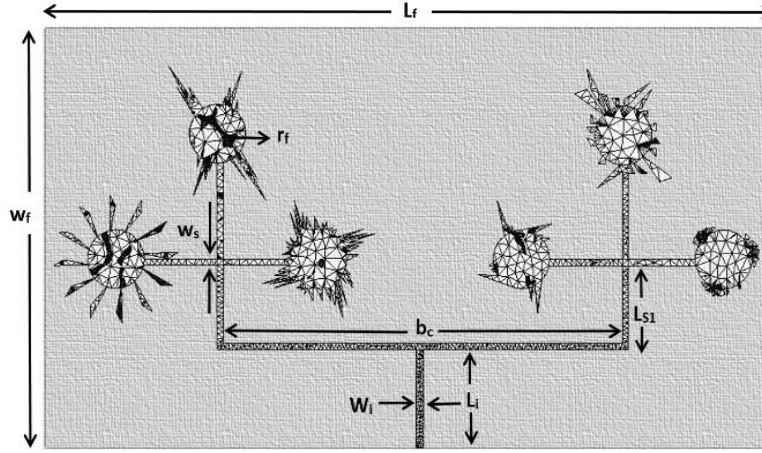


Figure 2. Framework of solar irregular contours on 14 mm fractal array with beam centers $b_c = 200$ mm to divulge sun-rise/daylight intervals (on left) and decaying (sunset) at radical-right by solar testimonies. On apex of antenna Sculpt-Technicalities $L_i = 47$ mm, $W_i = 4$ mm, $L_{s1} = 40$ mm, $W_s = 3$ mm fenced by (360×200) mm Rogers RT/duroid 5880 under 1.575 mm thickness.

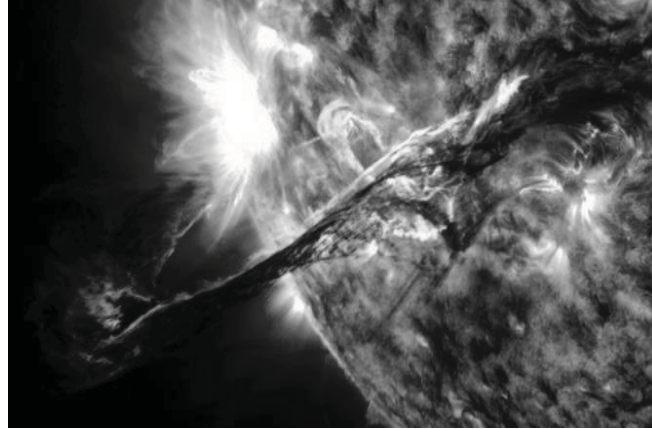


Figure 3. Solar Dynamics Observatory: sun's propelling with sunspots at pinnacle in 2013 as a slice of the sun's 11-year cycle, Living With a Star (LWS) Program $\langle$ NASA SDO Mission Images $\rangle$, crusading High Gain Antenna System (HGAS) on space-weather markers @ 150 MB/sec via 26 GHz Ka-band, SDO gizmos to the ground system.

with

$$\int_{4\pi} F_p(\psi_0, \phi_0, \psi, \phi) d\gamma = \gamma_S$$

where γ_S demarcates the antenna radiation-pattern solid angle. It evokes beam-averaged sun brightness temperature over the solid angle γ_S of the main beam rheostats antenna boresighting with allusion to solar diameter as presented in Eq. (6). Several remote sensed data measurements of the atmospheric events are brightness temperature of ground-based receiver excluding the cosmic noise impact of 2.7 K and extra-terrestrial sources between 1–340 GHz and 1–60 GHz with radiative transfer function on ITU-R atmospheric sky-noise paradigm [58]. The brightness temperature escalating of the ocean surface at 19.35 GHz with wind momentum stipulates underlying measures of storm detection. The microwave measurements of co-located over extreme events, copolarized and cross-polarized normalized radar cross sections (NRCS) of Sentinel-1 C-band synthetic aperture radar and L-band ocean surface roughness brightness temperature (T_B , rough) have been directly contrasted [59] under weather inconsistencies.

Inevitably, radio-astronomical antennas steering to the cold sky-noise flux generated in the ambiances as stockpiled by feeler with atmospheric parameters (temperature and humidity), antenna location, and pointing with site elevation have been itemized [60]. In moment of the natural prodigy, solar transits at distinctive timing intervals yearly and microwave radiation from the sun proceed as a root of interference, escalating the effective noise temperature of the satellite receivers and instigate operating deficiency of the remote sensing in terms of sun-outage. Moreover, sunspots emission is equitably circularly polarized, even though the attitude has been offset by random polarization of the thermal emissions from quiet Sun [61]. The stratagem of the sun's brightness temperatures at microwave frequencies and antenna noise temperature pointing at the sun can be projected. The prognosis of the sun [26] over antenna noise temperature difference ΔT_N with elevation angle ψ_0 and azimuth angles switching [towards sun $\phi_0(ts)$ and on-off sun $\phi_1(os)$] of the beam points antenna to adjudicate heights of the interference through sun movement along its diurnal ecliptic.

$$\Delta T_N(\psi_0, \phi_0, \phi_1) = T_{Nts}(\psi_0, \phi_0) - T_{Nos}(\psi_0, \phi_1) \quad (7)$$

As in the state, antenna noise temperature difference ΔT_N extricates control impending from multifarious sources, sky, and circa noise from radio receivers [62, 63] envisaging from preamplifier, radiation loss between antenna feed and the preamplifier, and thermal emission from sun and surroundings [55]. It also entails solar flux density through span of pattern measurements with expedients sensitivity. In proportion to solar circumferential span, apparent angular diameter of 0.53° (at the equinox) of the Sun at microwave frequencies is marginally bigger than the optical diameter. Consistently, Earth-Sun distance diverges faintly during the year, in the variant solar diameter and brightness temperature amendments [61]. The antenna interchanging (azimuth, altitude) tilts to grasp zenith and spatial dependences of the main-beam efficiency, meta materials, reflective surfaces attenuation and radio waves absorption to testify the polarization of the solar emission. On the fitting ascension Eq. (8), antenna noise temperature difference ΔT_N interrelated to solar-antenna milieu transits through the observer's meridian:

$$\Delta T_N(\psi_0, \phi_0) \cong \eta_N(\psi_0, \phi_0) T_{BV} e^{-\tau(\psi_0, \phi_0)} \quad (8)$$

whereas η_N evokes the beam filling factor reliant on effective aperture and antenna temperature for solar activity, and T_{BV} characterizes [53] atmospheric path attenuation of sun and Langley extrapolation [52]. It apprehends trajectory path of antenna traces in two angular directions with main beam temperature evoking surface brightness to unleash degree of intensity. The solar cycle variants of brightness temperatures at microwave frequencies [25, 60, 64, 65] on radiant power flux F_{sun} in the atmosphere:

$$F_{\text{sun}} = \frac{2kT_A(\psi_0, \phi_0)}{\eta_N G_N} \quad (9)$$

where G_N is the antenna aperture, T_A the inwards source antenna temperature, and η_N the antenna-to-antenna variations, occurring from manufacturing tolerances and imperfections in the radio devices, tilt and rotation of the antenna beams due to the terrain gradients [65], along lineages of tell-tale Eqs. (8)–(9).

It has been disentangled to retrieve antenna-designs, atmospheric loopholes swirl-wandering radiations and eventually affects core beam antenna efficiency in the space. The solar interference and shrill brightness temperatures witnessed during ambience variants on remote setups accuracy trace streams of non-thermal electrons in the corona, and in the interplanetary with view point of citadel radio-antenna archetypes.

4. FRACTAL TENTACLE-TACTICS WITH SOLAR SCANNING AND RADIO FLUX IMPETUS ON BEAM BORESIGHTING

Radio observations from the Sun persist as being compelling, penetrating and multifaceted. It inhales life on cosmos electromagnetics by spying solar corona, galactic cosmic rays, and staggering manners of magnetosphere in consort with solar-atmospheric propagation modeling [66]. In the occurrence, dimensional and radiation outlook of the sun beam position can indorse the antenna designers to reveal solar activities with optical disk imprint to decrypt the antenna focus [61]. The sun emits radio-flux energy engendered from atmospheric layers higher in the chromosphere and lower in the corona

with discrete frequencies (RSTN/Penticton 245 MHz and 15400 MHz at corresponding corona heights), transformed progressively on daily basis, pertaining to the number and size of spot groups on the solar disk. The RSTN/Penticton fluxes by NOAA Solar data services [67] obtained at frequencies in the span of 245 MHz to 15400 MHz specifying quiet-sun radio fluxes and measures have been grasped to rectify them centered on the cumulative elements such as antenna gain, bursts progression, atmospheric absorption, and sky temperature. At 2800 MHz (10.7 cm) flux indicators (observed/adjusted) summed over the Sun's disk, adjusted fluxes expressed statistics without fluctuations, i.e., the energy captured at the mean distance between Sun and the Earth.

Surface emissivity and microwave brightness temperature (T_b) were witnessed from retrieval of land surface with solar insolation (I) on Runge-Kutta-Fehlberg solution [68]. Owing to the TRMM orbital geometry, 10.65 GHz measurements attenuate by cloud cover and are also implicitly weighted from cooler land surface physical temperatures on overcast events. While land surface physical temperature supervenes as function of incident solar energy, TMI 10.65 GHz T_b data with its diurnal sampling can be taken to investigate the tie between solar insolation (I) and surface T_b responding. The experimental solar insolation miens vary on different yearly intervals and reflect the ambiance impact (e.g., atmospheric species absorption, scattering and absorption by aerosols and clouds). The contemplations of Tropical Rainfall Measuring Mission (TRMM) Microwave Imager (TMI) brightness temperature at 10.65 GHz vertical polarization infers assorted cognizance into the surface soil moisture incarnations with inclined angles of sun-earth geometry and anticipate the ongoing drought in Lower Colorado River basin (LCRB).

On acquiescing to the nature-space fractal ache, slanting of the solar gravitas with flares and sky glares, projection of the fracto-sun antenna across dawn/dusk phases with multiscale triangular segments in this fostering has been consummated. In this antenna array, six constraints have been involved in a circularly symmetric genre adjoining angular distance r_f from the beam center in lieu of each gleam. The fractal array radius channels $r_f = 14$ mm with spacing between dual beam centers $b_c = 200$ mm manifesting (360×200) mm substrate with 1.575 mm thickness within Rogers RT/duroid 5880 of $\epsilon_r = 2.2$ permittivity, inset feed width $W_i = 4$ mm, inset feed length $L_i = 47$ mm, stripline length $L_{s1} = 40$ mm, conciliating idiosyncratic solar stages at vertical and stripline width $W_s = 3$ mm by horizontal transmission line as earlier conscription in Fig. 2. The 3D fractal-sun array exploits the Sun as a beacon source by reconnoitering along its diurnal ecliptic with Directional Angle (DA) of sun bearing as guides in Fig. 4(a). The earliest periods of buoyant sun on left flank of antenna stipulate intense sunlight intervals to conduct the sun scan while right flank fractals grant decaying intervals to extricate solar fluxes with reciprocal shares of the day as shown in Fig. 4(b). The

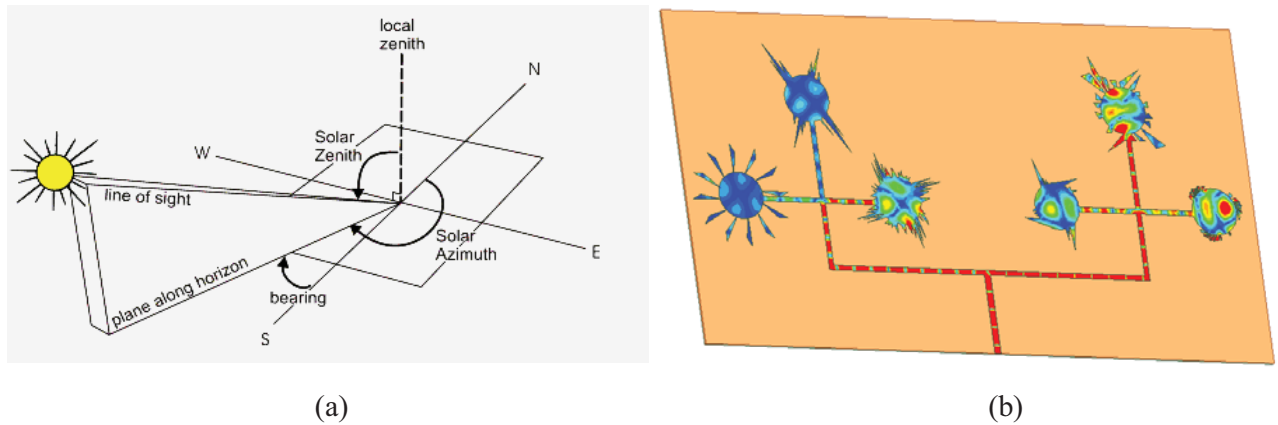


Figure 4. Up-and-coming fractal sun ambience outfits in time and space: (a) Irradiating the sun's position with azimuth (DA of the sun protruded clockwise from the north along the horizon) and Zenith (Angle pondering between the local zenith and solar's sightline). (b) Solar carryings-on with lop-sided triangular fragments on the sky pattern beam (ψ, ϕ) power allocated by ON-OFF pointing territorial brightness temperatures $T_N(\psi_o, \phi_o)$.

data compendium [65] on solar and planetary brightness temperatures meets absolute flux density at 86.1 GHz towards calibration of 3-mm radio astronomical adherences with accuracy (1σ) of about 3% percent. The solar brightness temperature on conical horn (7914 ± 192 K) agreed with the chopper-wheel calibration technique using the 4.9-m reflector. During the 1977, astronomies period was sheathed by absolute brightness temperatures of sun on conical horn at December 17, 18-(2000 UTC hrs.) with flux density $\{(125.3 \pm 4.8) \times 10^6 \text{ Jy}, (123.8 \pm 3.8) \times 10^6 \text{ Jy}\}$ calibers. The stellar intuitions of brightness temperatures on Venus (357.5 ± 13.1 K), Jupiter (179.4 ± 4.7 K), and Saturn (153.4 ± 4.8 K) were espied by paraboloidal reflector within assorted 06-days of December 1977 and November 1978 at 3.5 mm wavelength. The sun-earth adhering fractal sequel with self-similar matrices of the fine structure constant of solar electromagnetic force and its inverse is multiplied by the Carrington Synodic rotation period of the sun with 98% of the principal one hundred frequencies and periodicities from Active Cavity Irradiance Monitor (ACRIM) satellite and terrestrial 10.7 cm Penticton Adjusted Daily Flux records. The self-similarity allocates sculpting of time-space differential equation uttering solar model dive for transmissions across core, radiative, tachocline, convective and coronal regions [14].

To perceive the solar disk with uniform sensitivity, probing the unbiased flux generation, antenna noise temperature drives to be measured by alternately pointing the antenna towards and away from the sun corresponding to beam-altercation tactics. By milking the sun as a background source at the antenna core with elevation/azimuth scanning has been evaluated at X-band. It judges peripheral constraints of the apparatus and location, coining the flux appraisal being sensitive to variations in the surroundings such as the oxygen and water vapor influences in the troposphere [25, 58]. By appositely taking the switching time interval during diverse day intervals and captivating the main lobe aperture, atmospheric attenuation Eq. (8) in all-weather situations along the empirical path extrapolates through indirect estimation of the difference between two measurements [26, 57]. The antenna noise temperature is instigated by solar radiation contingent on the beamwidth of the antenna Eq. (6) and proportionate location of its boresight axis to the sun disk. In fact, antennas revolt drastically as pointing angle swings from horizon to zenith with elevation angles $\{\frac{\pi}{2} \text{ to } \frac{2\pi}{3}\}$ impending beam filling factor; system noise temperature proportionally heaps with zenith angle whilst gravity distorts the edifice as antenna skews away (up/down) from the rigging angle 90° . Unvaryingly, stray radiations of side lobes involve the shards received from earth's surface and spawning from the atmosphere [58] by the strongest side lobe level (SLL) stares in a 20° wide sector from 32° to 52° polar angle and petite side lobes at higher offset angles around 60° adjacent to the core flamboyant region in Fig. 5(a). In Fig. 5(b), antenna's full-width half-maximum (FWHM) relative to a circular disk originated by sun phases with dissimilar

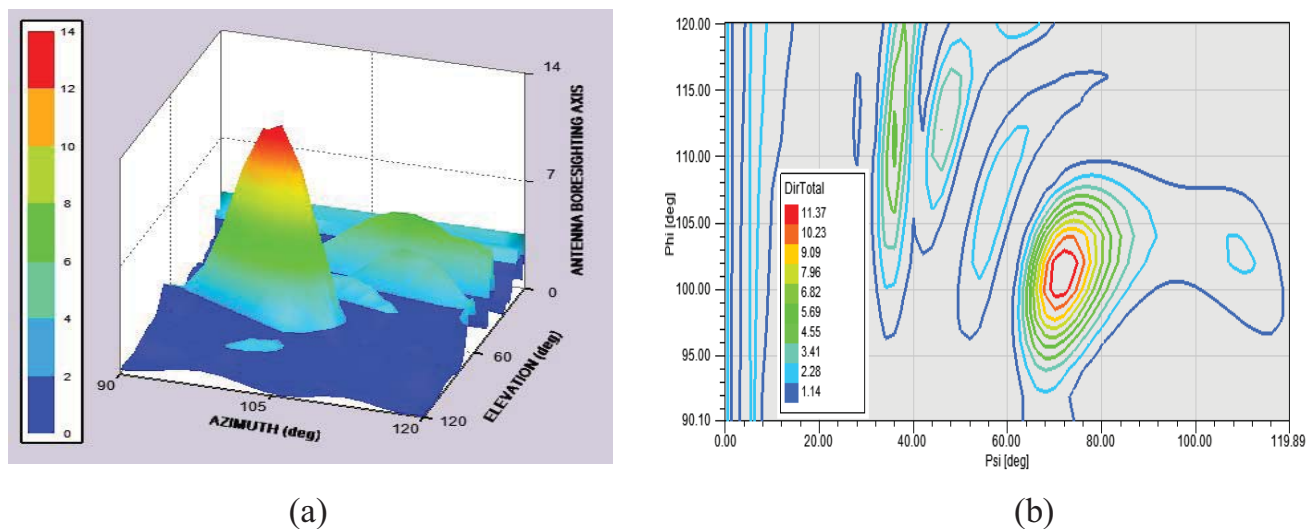


Figure 5. Buttonholing the gyration drifts: (a) Antenna solid ray Sheathingat azimuthal offset (60° – 80°) to sun-disposition, median elevation offset 102° on beam-swaps. (b) Slanted beam-contour and boresight asphyxiates sidelobes of the uniform distribution whilst acclimatizing the sidelobes altitude.

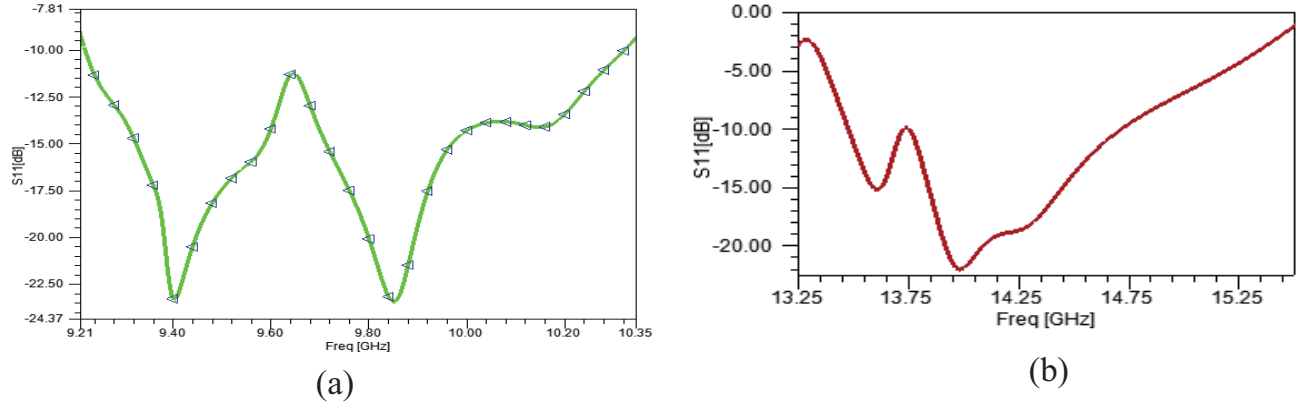


Figure 6. Simulated return loss S_{11} on irregular triangular iterations (a) X-band and (b) Ku-band reflectivity tests sequentially.

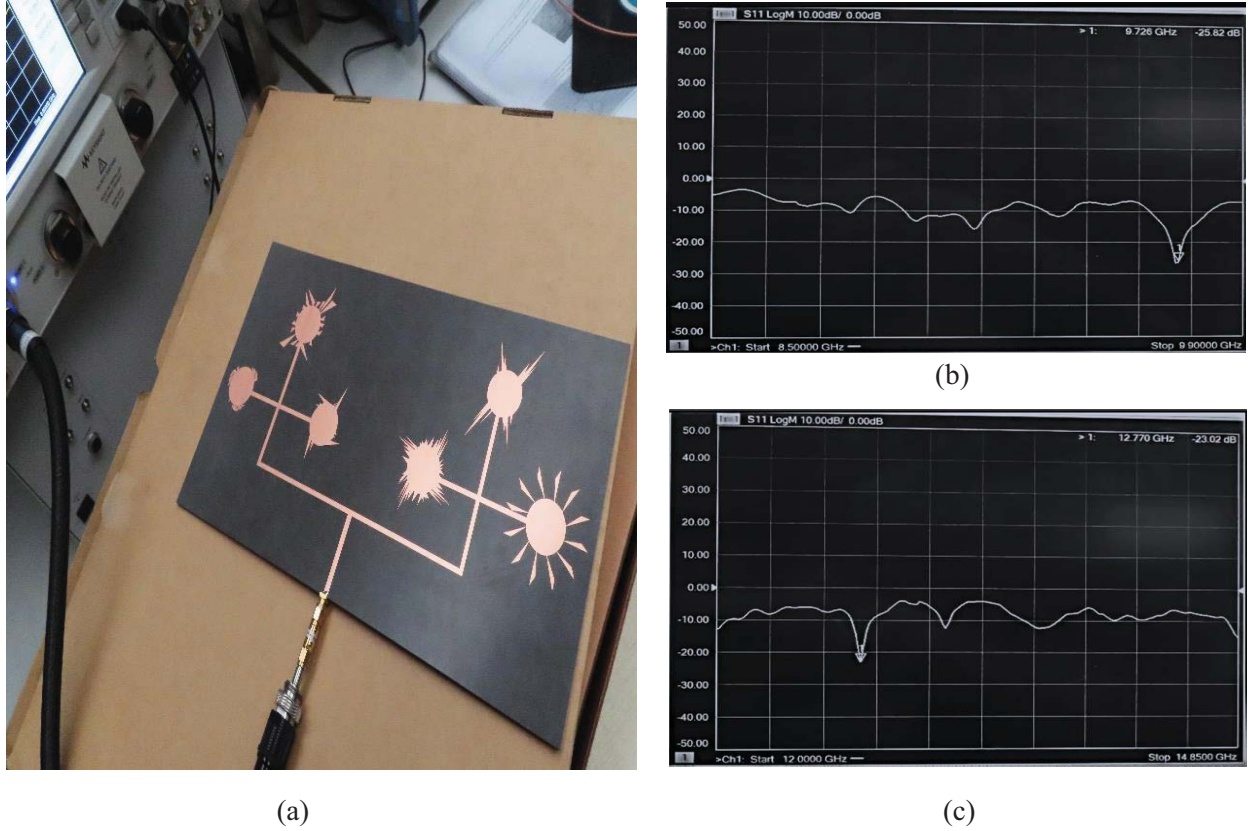


Figure 7. Fracto-Sun tentacle measurements: (a) Stance-on network choreographing (UUT testing), (b) X-band, (c) Ku-band on single port measured reflection co-efficient corollaries.

day intervals has been revealed with antenna boresighting 3-dB beamwidth. Accordingly, quiet sun or moon can be approximated as a uniform circular disk [56] with source angular size weights (0.53° around sun stances) [61] on the fallouts of antenna half-power beam width (HPBW). Several solar radio observatories in antecedent [69] with scanning the sun approach through radio telescopes engrossing fan beams or pencil beams and pondering solar eclipse curves. From October 1960 to March 1964 solar flux and brightness temperatures are contrived with 10ft. horn fed reflector at Tübingen, Germany

on solar transits. The radiometric accuracy with blackbody calibration targets to deliver reference brightness temperatures has been consummated by antenna-target coalesces, measuring the difference in reflection coefficient for near and far targets [70], metaphors of the load configuration, thermal and radiometric performance with coherent backscatter or S_{11} reflectivity and emissivity tests conducted [71]. Enveloped by intrinsic nucleus, stirring an electromagnetic environment overcomes imperfections by billeting beam patterns without reflections flanks high frequencies scattering losses measurements. The resultant antenna attenuation $|S_{11}| < -10$ dB quantifies scattering from antenna's tripod as sun's stance allocation. Figs. 6(a) and (b) display the simulated beamwidth's stability (computed from the scattering loss data S_{11}) at X-band and Ku-band resonant frequencies of 9.40 GHz, 9.85 GHz, and 13.98 GHz successively, thenceforth communicating with the antenna prototype model at 9.726 GHz and 12.77 GHz on measured reflectivity tests in Fig. 7 under VNA passivity trials.

5. CONCLUSION

The fractal sun natural silhouettes in time and space have disinterred self-similarities with imitating contours of the phase variations in the sun's magnetic field, harmonized with catastrophic aftermaths within the earth's climatic, biological, and geological records have underpinned fractal model of the solar clock of chaotic determinism. Unswervingly, solar interference and high brightness temperatures transpired in radio bursts indicate remote sensing positional accuracy with radio flux data observations. Moreover, cosmos-radio proliferation mandates space and terrestrial protrusions, interplanetary radio-signaling of the phase fluctuations near ground surfaces. In the corollary, self-semblance patterns and fractal random traits of the antenna solar scan sequels with relationship of climatology to radiate broad array of propagation modes have been shadowed. In the inference, coupling approaches to accede surface asymmetry chattels in consort with band limited Weierstrass $C(x, y)$ and radio fluxes/brightness temperatures on space-electromagnetic sequel. On the sun's zenithal index with azimuth $\langle \frac{\pi}{2} \text{ to } \frac{2\pi}{3} \rangle$ and elevation $\langle 0 \text{ to } \frac{2\pi}{3} \rangle$ rotary positioning, higher offset from the sun to trigger antenna pointing make-up and off-source orientation pivots on reverse flanks of the source to account for any background sky temperature gradients through the source. In this paper, antenna solar scan culminations at X-band to detect the drift of solar activity with fractal boresight physiognomies of 3-dB HPBW around 0.5° solar diameter, return loss $S_{11} < -10$ dB at X-band (8 GHz to 12 GHz) and Ku-band (12 GHz to 18 GHz) resonant frequencies on horizontal and vertical tilting miens are tested.

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