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Signal Strength of one-route of a TV stationoperating at UHF band in Nigeria

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Abstract
Television (TV) broadcasting stations radiate signals to the surrounding areas using free space. These signals are received using appropriateTV reception antennas. The energy level of radio signals decrease rapidly as the distance between the transmitter and the receiver antennas increases. In the light of the importance of television broadcasting to the socio-economic development of the populace, viewer's interest has shifted and grown from just watching anything on the screen to qualitative, clear and sharp signals on the television screen. This researchcaptures part of the data obtained from measuring the Signal Strength of two TV stations operating at UHF band in a metropolitan environment in Nigeria. Thetelevision signal coverage area of the two TV stations, broadcasting at 535.25MHZ (station 1) and 698,00MHZ (station 2) were considered for investigation.
The electric field strength of the transmitters of the two stations was measured radially, along five different routes with the transmitting stations as references. Station 1 broadcast at 535.25 MHZ (AIT), while station 2 broadcasts at 698,00MHZ. (sty).These measurements were taken with a Handheld field strength meter, (saluki, model: 53331b) and a Handheld GPS receiver, (Garmin, model: MAP 645), which was used for determining the geographic coordinates of the various sample data points from the base stations. Signal strengths were collected from the two stations through different routes. The data collected were used to classify the various grades of coverage, as far as the various villages and towns within the coverage area (zones) was concerned.
This paper discusses only the data for Station 1 route 1 while other data will be presented in subsequent papers.Based on the average values of signal strength in Table 1, which are all above 20 dBμV, it means that the signal strength along station 1 route 1 is admissible.
Keywords: *TV stations, Signal Strength, Electric Field, UHF band, Longitude, Latitude, Elevation.*

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I. Introduction

Duran (2018) said that Broadening the coverage of radio and TV signal is the primary concern of radio and TV administrative authorities, especially for remote rural regions, where the radio and TV signal are unstable. Television (TV) broadcasting station uses free space to relocate signals to the mounding area. appropriate television reception antennas are used to received the signals. Galati (2016), Oestgen et al (2011) and Ogbende (2014) highlighted that a careful choice of the TV receiving antennas is necessary for obtaining quality reception from desired broadcast channels. They indicated that path that a radio signal takes depends on the frequency of the transmitted signal and also on the prevailing terrain.

II. Literature Review

A coverage area is a region where a radio or any transmitted signal can be received. All stations have their expected coverage area, and their signals should not constitute interference to others. Alunbolati et al (2015), Okpeki and Igbwosa (2021), Faruk et al (2013) and Kabiru et al (2016) mentioned that Coverage area are classified into primary, secondary and frunge coverage areas. The primary coverage area is defined as a region about the transmitting station in which electric field. Strength is strong enough to override ordinary interference at all times. This corresponds to area, where the signal strength is at least 40dBNV. The secondary coverage area is a region about the transmitting station, in which the signal strength is often sufficient to be useful but not strong enough to override interference at all times. This corresponds to the area where the signal strength is at least 20dBNV but less than 40dBNV. Fringe coverage area is a region about the transmitting station, where the signal strength is weak and not dependable, its service can neither be guaranteed nor be protected against interference.

Ajewole et al (2014) studied the coverage areas of Ultra High Frequencies (UHF) television signals in Ondo State, Nigeria, and the effect of precipitation on signal strength through quantitative measurement of the

electric field strength of these signals. They used Digital Signal Level Meter, Dagatron TM 10 type and a GPS MAP 76. The combined coverage areas of the three transmitting stations as a percentage of the State land mass was 72.5% for the onset of raining season, 67.5% during the peak of raining season and 75.5% during the early part of dry season.

Akinbolatia et al (2016) in their overall results show that elevation above ground level is a key factor to be considered for UHF transmission and reception (location of transmitters, transmitting antenna's height, directivity and gain. Mardeni and Priya (2010) in their research said that the higher the receiving antenna height, the better the signal strength received. Myungnam et al (2013) said any location on high elevation, will have the tendency of receiving better signal strength than location in a lower elevation (e.g location in a valley). In clear terms, the higher the transmitting antenna height, the better the signal received by the receiving antenna.Reddit (n.d.) in a post puts it that the elevation of the land surface of the Earth varies from the low point of −418 m at the Dead Sea, to a 2005-estimated maximum altitude of 8,848 m at the top of Mount Everest. Clearly, the average elevation in this measurement in Table 1 is within range.

Stackoverflow (n.d.) highlighted that the valid range of latitude in degrees is -90 and +90 for the southern and northern hemisphere, respectively.Longitude is in the range -180 and +180 specifying coordinates west and east of the Prime Meridian, respectively. Matthews et al (2018) concluded in their research that Signal strength generally diminishes with increase in distance. The Latitude and Longitude, which are the coordinates of each location (or sample point) from the transmitter, gives rise to the distance of each location (sample point) from the transmitter. Imranullah et al (2012) in their article said, the closer a location (sample point) is, to a transmitting antenna, the better the signal reception.In essence, as the distance from the transmitting antenna to the receiving antenna increases, the signal strength decreases. Okumura et al (1968), Ajayi and Owolabi (1979) and Hata (1980) in Duran (2018) specified that a signal strength of 20dBμV is unacceptable.

III. Methodology

The equipment and materials used in this research are a handheld field strength meter (saluki, model: S3331B). A Garmin GPS receiver, model: MAP 64s was used for measuring the coordinates of the various sample points. Other facilities used include field value (car), stop watch, receiving antenna, and the administrative map of the environment being considered for investigation.

Measurement of electric field strength of the two TV stations were carried out radially from each TV broadcasting station, along five different routes. Measurement and data collection were made using the field strength meter and GPS receiver. The data from the field strength meter is what is presented in this paper.

IV. Results and Discussion

The part of the data obtained from station 1, having a frequency of 535.25MHZ are presented in the Appendix. In particular**,** only the data along route 1 is capturedin the appendix and it is also the only one addressed in this paper.While the raw results of the research measurements are in Appendix, the average values are in Table 1. From the appendix, the values of the latitude and longitude, which are the coordinates of each location (or sample point) from the transmitter are presented. They give rise to the distance of each location (sample point) from the transmitter. As the distance from the transmitting antenna to the receiving antenna increases, the signal strength decreases. It means then that the distances of 30KM and about had less signal strength to those with less than 30KM. The signal gets toloss completely at a point where the distance is too far. In this research data, all the specified data carries signal except that the shorter distances carry stronger signals. From Table 1, the average values of latitude and longitude are 9.0408 and 7.324226 respectively. Based on the theoretical framework, the average latitudes and longitudes are within the valid range.More so, the average elevation in this measurement in Table 1 is within the valid range. Based on the given research data in the appendix, we have signal strengths who were less than 20 dBμV, which are considered as unacceptable by research accolades in Telecommunication. But, for average values of signal strength in Table 1, which are all above 20 dBμV, it means that the signal strength along station 1 route 1 is acceptably good.

Table 1: Average Values of the obtained data

Latitude (^{o}**N**)	**Longitude** (^{o}**E**)	**Elevation** (**m**)	**Distance** (**T-R**) (**km**)	**Signal Strength X** (**dBμV**)	**Signal Strength Y** (**dBμV**)	**Signal Strength Z** (**dBμV**)	**Mean Signal Strength** (**dBμV**)
9.0408	7.324226	306.6691	28.17982	21.73745	20.93655	21.36545	21.34655

V. Conclusion

Based on the average values of signal strength in Table 1, which are all above 20 dBμV, it means that the signal strength along station 1 route 1 is admissible.

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Appendix: Data from Station 1 Route 1

Latitude (°N)	Longitude (°E)	Elevation (m)	Distance (T-R) (km)	SignalStrength X (dBμV)	SignalStrength Y (dBμV)	SignalStrength Z (dBμV)	MeanSignal Strength (dBμV)
9.067783	7.487467	508.5	0.00	42.44	40.45	41.37	41.42
9.05900	7.492117	488.9	1.10	41.84	40.26	40.30	40.80
9.055500	7.498400	493.0	1.82	40.23	40.50	40.68	40.47
9.059717	7.502217	409.1	1.85	38.43	36.40	37.01	37.28
9.051400	7.511900	523.9	3.25	35.66	32.30	34.40	34.12
9.050100	7.519817	545.1	4.06	33.32	29.50	32.10	31.64
9.050133	7.519917	560.9	4.07	33.32	30.12	31.60	31.68
9.033583	7.504867	515.4	4.26	32.88	29.36	29.68	30.64
9.026967	7.472883	498.4	4.82	32.46	28.52	30.25	30.41
9.049167	7.527317	509.4	4.85	32.46	28.07	30.40	30.31
9.026067	7.470833	486.2	4.99	32.46	27.85	29.36	29.89
9.016083	7.494583	519.7	5.81	26.30	23.60	25.40	25.10
9.022783	7.448317	470.6	6.60	22.40	21.05	21.11	21.52

9.005317	7.427467	442.5	9.58	20.62	20.30	20.52	20.48
8.997667	7.407967	430.7	11.72	20.15	18.25	19.50	19.30
8.981333	7.382467	426.2	15.03	19.56	19.01	19.06	19.21
8.970783	7.360817	390.6	17.62	19.41	19.20	19.35	19.32
8.962150	7.345733	391.3	19.52	19.26	19.20	19.26	19.24
8.943983	7.323617	354.3	22.68	19.10	19.11	19.12	19.11
8.940817	7.301150	337.3	24.89	18.74	18.40	18.84	18.66
8.948083	7.278100	341.9	26.60	18.52	18.24	18.47	18.41
8.954000	7.262550	328.7	27.78	19.12	19.07	19.11	19.10
8.961350	7.244283	324.7	29.24	18.96	19.26	19.44	19.22
8.972433	7.219600	324.2	31.30	18.83	19.45	19.92	19.40
8.981900	7.199333	303.4	33.09	18.70	18.40	18.76	18.62
8.989083	7.187700	286.7	34.10	18.52	18.30	18.41	18.41
9.002467	7.165750	256.3	36.11	18.41	17.20	17.40	17.67
9.004783	7.153417	253.0	37.39	18.30	17.21	17.23	17.58
8.983617	7.142133	253.0	39.10	17.92	18.50	18.78	18.40
8.968383	7.130483	233.3	40.78	18.64	18.30	18.65	18.53
8.955033	7.117467	212.3	42.57	18.22	17.40	17.63	17.75
8.945067	7.097050	210.3	45.05	17.85	17.60	18.01	17.82
8.933817	7.092800	191.2	45.88	17.60	17.63	17.66	17.63
8.928050	7.091917	199.5	46.19	17.48	17.50	17.57	17.52
8.913250	7.087150	197.4	47.26	17.32	17.24	17.34	17.30
8.893233	7.071917	195.7	49.65	17.22	17.16	17.25	17.21
8.876783	7.064533	221.0	51.13	16.44	17.40	17.49	17.11
8.853050	7.054217	203.5	53.30	16.52	16.38	16.54	16.48
8.830367	7.049067	195.9	54.98	17.15	16.56	16.75	16.82
8.812317	7.034633	197.3	57.34	17.00	17.60	17.84	17.48
8.798950	7.012333	191.0	60.21	16.82	16.60	16.68	16.70
8.781267	6.993217	192.2	63.02	16.66	16.45	16.69	16.60
8.762600	6.975117	191.6	65.79	16.40	16.48	16.62	16.50
8.742400	6.956967	179.6	68.67	17.35	15.60	16.28	16.41
8.720883	6.946217	164.4	70.95	16.30	16.28	16.38	16.32
8.702283	6.936883	138.3	72.95	16.21	16.17	16.22	16.20
8.677783	6.928733	105.0	75.24	16.16	16.08	16.18	16.14
8.652283	6.921900	138.9	77.52	16.12	16.01	16.11	16.08
8.625433	6.916717	164.1	79.79	15.84	15.80	15.85	15.83
8.600550	6.911983	195.1	81.93	15.72	15.80	15.88	15.80
8.576917	6.915400	154.7	83.34	15.60	15.80	15.85	15.75
8.551017	6.922883	156.3	84.65	15.50	15.55	15.75	15.60
8.528767	6.929350	185.3	85.85	15.42	15.46	15.35	15.41
8.503450	6.936667	197.5	87.28	15.32	15.30	15.28	15.30
8.477433	6.943800	146.2	88.86	15.22	15.16	15.25	15.21
8.464600	6.940333	135.3	90.18	15.16	15.12	15.17	15.15