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Semi-Automatic Monitoring in Monitoring the Privacy of Electricity Transmission and Super Distribution Lines in Yazd Province Using Time Series Analysis of Radar Images (A Case Study of Jumhouri Blvd.)

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Abstract

Today, the electricity industry is considered one of the most vital industries of a country, and considering that the passage of electricity transmission lines in each region has different effects and radiation depending on its voltage, so in order to preserve human health, plant growth and prevent financial losses, Privacy must be respected. One of the optimal methods in semi-automatic monitoring and monitoring of illegal constructions is the use of remote sensing and the use of radar images. In this research, Sentinel 1 radar time series images were used to monitor the security of transmission and super distribution lines, which after applying pre-processing Necessary in SNAP software, In order to extract the zero sigma dispersion coefficient of the images and make them binary, 100 sample points were taken as a statistical population from the Landsat images and the threshold limit of the construction of two images were calculated and the number 0.081003 was obtained as the threshold limit, and then by creating the privacy layer of the transmission and hyper distribution network and overlaying it with the fuzzy images, the amount of interference The constructions were determined by the structure of the network privacy and also the illegal constructions were identified during one year with the pixel-based algorithm and at the end drone images were used for validation, the results of this research indicate that most of the illegal constructions can be identified using the method presented It was identified semi-automatically with 85-90% accuracy and increased the speed of identifying illegal constructions in privacy.

***Keywords**:* Radar Images, Sentinel 1 Satellite, Time Series, Pixel-Based Algorithm, Zero Sigma Dispersion Coefficient

1. Introduction

1.1. Statement of Problem

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Electricity is one of the most important sources of energy in today's era, which plays a vital role in human life today. During the last century, the use of this energy has increased, and of course, how and how to transfer this energy has become a complex and important matter. On the other hand, we know that construction projects have always been one of the large and important parts of the economic and social activities of the country, which due to the extent of electric power networks at the urban and rural levels and the activity of the construction and housing sector next to these networks, from time to time we witness the violation of legal boundaries (privacy). Power grids, by this sector of the industry (Tavanir, 1997).

Due to the expansion of overhead power networks in cities and rural areas and the proximity of residential spaces and human proximity to transmission and super distribution networks, the sense of danger for the operators of electricity transmission and super distribution has multiplied. The construction near the high-voltage power lines and even under such networks has caused many life and financial risks, and the discussion about compensation for these damages includes social costs, especially legal ones, and inflicts heavy financial blows on the power companies. In fact, what compels us to observe privacy, in addition to saving human lives, is avoiding financial losses to electricity companies and maintaining the quality of service delivery and optimal use (Zargar and Meghridi, 2011). To ensure the safety and reliability of power transmission systems, power companies must ensure that these components maintain an adequate safety margin from the surrounding environment and one of the common tasks of risk management is the inspection of power lines (Kashi et al., 2021).

1.2. Importance and Necessity of Research

Various methods are used to monitor the encroachment of the privacy of power transmission lines, the most traditional of which is the presence of privacy experts and the method of manual line inspection. Manual inspection of transmission lines as a traditional method has obvious disadvantages such as long inspection cycle, low efficiency and very expensive work. Since many lines are located in the suburbs or even uninhabited areas, manual line inspection requires a long journey to get there, and when it comes to special terrain and weather conditions, this often leads to low inspection efficiency. And it does not always guarantee the safety of personnel (Li et al., 2021). On the other hand, techniques such as LiDAR ،drones or land-based mobile mapping data (Dai et al., 2022) that use unmanned aerial vehicles and airborne facilities to detect transmission line encroachment are very expensive. Therefore, remote sensing and radar satellite images are an optimal and automatic solution for monitoring transmission line trespasses in large spatial areas, and radar images have many advantages over other methods due to their lower cost and wide area inspection coverage. Therefore, it can penetrate the entire earth cover without restriction. The use of satellite images and data in a very short period of time can provide experts and specialists with very diverse and expressive maps of the changes in the level and height of buildings, and it also provides the possibility of preparing a map of the area of buildings in annual, monthly and even shorter time periods (Sultani and Sarkargarh, 2014).

1.3. Literature Review

There are many studies on the use of satellite and radar images to monitor and identify constructions, including Soltani and Sargargar in the study of the boundaries of buildings, from high-resolution satellite images (quick range) with object-based classification methods for identification and constructions. In this research, multi-spectral and panchromatic images of quick-range satellite bands 1 to 4 were used, and in minimum time and cost, the unauthorized built areas were obtained by comparing licensed property maps. (Sultani and Sarkargar, 2014) and Ghorbani et al., in a study, extracted the 3D changes of buildings in Mashhad city using images with high resolution and 3D spatial database. In this research, the ability to produce DSM from stereo images was used In this method, 88% accuracy and 81% accuracy were achieved in semi-urban areas and 91% accuracy and 87% accuracy in urban areas. (Mohammadabad and Ardakani, 2013) and Khalili Moghadam et al., in a study, studied the semi-automatic monitoring of illegal constructions in the urban area using satellite images and the pixel method based on the fuzzy or implicit operator. A field of buildings suspected of violation, the accuracy of illegal construction in the place of suspected violations was investigated (Khalilimoghadam et al., 2016) and Rokh Afrooz and Rahmanizadeh, in a study to detect changes in urban areas using SAR satellite images (SAR) discussed that using a threshold limit from the image histogram, the urban area was extracted and changes were revealed using calculations on the images. (Rukh Afrooz and Rahmanizadeh, 2018) and Sohrabi Mofard and Bakhtiari Kia carried out the project of detecting urban impervious surfaces using the textural features of the radar image. Maximum likelihood classification, artificial neural network and support vector machine were evaluated on the Sentinel1 radar image to determine the impervious surfaces of Bandar Abbas city, and the results show the suitability of the methods used to detect urban impervious surfaces. (Sohrabi Mfard and Bakhtiari Kia, 2020) and Mahmoudizadeh and Esmaili used a new method to improve the results of detecting changes by combining optical and radar images and using an unsupervised method based on the PSO algorithm, the findings of this research show high efficiency and accuracy. The developed method is to detect changes. (Mahmoodizadeh and Esmaeily, 2021) and Ehsan Kashi et al evaluated and analyzed the privacy of power lines in the city of Semnan using aerial images, and the results showed that in terms of complying with the approved privacy, most of the power towers in the studied area are in relatively good condition. are desirable (Kashi et al., 2021) and Mohammad Nejad, in a study, identified urban lands using Sentinel 1 and 2 satellite images based on the Google Earth Engine (GEE) system, which results show that the average Kappa coefficient for 20 cities is 16 It is 86.0%, the highest of which is related to the city of Rasht and the lowest to Kerman. Also, cities located in arid and semi-arid regions are less healthy. (Mohammednejad, 2020) and Li et al. studied automatic monitoring of power line routes using advanced aircraft control and multi-source fusion. This research presents a comprehensive research on remote sensing-based automatic power line path monitoring, focusing on recent innovations in the field of increasing automation of fixed-wing platforms for aerial data collection and automatic data processing for object detection using fusion process. The results of these tests and investigations show the effectiveness of the proposed aircraft feature fusion and control methods. (Li et al, 2012). Hame et al. monitored power lines using optical satellite data, and in this research, the main purpose of using satellite data was to maintain power lines in forest areas. The results show that satellite monitoring can be a become an important maintenance planning tool for power distribution companies in the near future (Hame et al, 2016). In a research, Matikainen et al. Effective power lines are needed, in this research the aim is to provide an overview of the possibilities provided by modern remote sensing sensors in power line range surveys and discuss the potential and limitations of different approaches, as well as monitoring power line components and The vegetation surrounding them is included in this research. (Matikainen et al, 2016). Haroun et al reviewed the detection of vegetation encroachment in power transmission lines using optical sensing satellite images. In this research, the current techniques used to detect Tjav vegetation cover using satellite images were investigated and classified into four sections, the results indicate that monitoring vegetation encroachment in the area of power lines using satellite images can replace other relatively expensive methods such as LiDAR and aerial surveillance (Haroun et al., 2020). In a study, Narges Ghane et al. have investigated the changes in vegetation cover, dust and wind flow in the last 40 years using satellite images in NASA's Giovanni and Sentinel-5P images in the Google Earth engine for western Iran. They have concluded that dust, vegetation, wind stress have had related changes during 40 years and there is less dust in areas with more vegetation (Ghane Ezabadi et al., 2021). In a research, Zohra Salehinejad has presented a framework for quick and low-cost estimation in monitoring constructions and identifying unauthorized urban buildings using the time series analysis of Sentinel 1 satellite radar images, the results of which indicate the high accuracy of the maximum likelihood method with accuracy The overall accuracy is 0.89 and the Kappa coefficient is 0.83% relative to the random forest method with the overall accuracy of 0.86 and the Kappa coefficient is 0.81%.(Nejad and al-Madrsi, 2022)

Considering that several researches in the field of detecting changes by using optical and radar images have been done individually by researchers in this field, and considering the advantage of simultaneous use of radar and optical data in the discussion of change detection, it is possible to use only the data of one sensor that Past research has been used as a drawback. Also, the methods implemented in the past research, for combining radar and optics data and thresholding in order to detect changes, have a series of defects and shortcomings. For example, in some of these researches, methods have been used that require entering a series of parameters or training data (supervised classification) by the operator, as mentioned in the supervised methods, the skill and experience of the operator to determine parameters and collect training data will have a significant impact on the results, or on the other hand, techniques such as LiDAR or drones, which use unmanned aerial vehicles and airborne facilities to detect transmission line trespass, are very expensive, so in this research, in order to overcome the problems and defects In the past research, an unsupervised and semi-automatic method was used to detect illegal constructions in the border by using radar images and sampling optical images.

1.4. Research Question

1. Is it appropriate to use remote sensing and radar data of Sentinel 1 satellite to reveal the limits of violation of power transmission and super distribution lines and semi-automatic monitoring analysis?
2. Is the use of semi-automatic monitoring technique capable of predicting and monitoring unauthorized constructions and violating the privacy of transmission lines with high accuracy?
3. Does the use of semi-automated monitoring technique in identifying illegal constructions in privacy save time and money compared to traditional methods?

1.5. Research Objectives and Aims

Since power transmission lines in urban spaces, in parallel with their many benefits, may cause problems such as the production of electric and magnetic fields, the production of radio interference, the destruction of the natural environment, the destruction of gardens and agricultural lands in the course of construction, creating risks for residents located nearby. privacy from the point of view of establishment in the magnetic field of the network (Amini, 2020), therefore it is necessary to choose areas as privacy and as a result, prohibit the construction of various types of facilities or residential or non-residential buildings in it, and since the issue of the privacy of electricity is related to construction In the vicinity of power lines, it is necessary to avoid building constructions in the vicinity of the electricity sanctuary in the first place.

Therefore, to prevent the continuation of unauthorized constructions and to identify them, it should be significantly cost-effective and fast, and accurate and up-to-date location-referenced information is needed for proper management and planning. Obtaining multi-temporal satellite images and using image processing techniques for automatic change detection is one of the optimal methods that can be used in monitoring unauthorized constructions and devices. In line with the main goal of this research, the following goals are also considered:

1. Providing an algorithm to detect illegal constructions in the privacy of electricity transmission and super distribution lines using time series analysis of radar images and semi-automatic monitoring
2. Management and planning as best as possible to identify illegal constructions in the right of way
3. Minimizing field visits and targeting the visits of privacy experts
4. Reducing time and cost in monitoring and identifying privacy violations
5. Preventing damage and financial losses to electrical equipment and increasing the safety of maintenance personnel

2. Materials and Methods

2.1. Study Area

Yazd province is located in the central part of the plateau of Iran, between latitudes 29 degrees 52 minutes to 33 degrees 27 minutes north latitude and 52 degrees 55 minutes to 56 degrees 37 minutes east longitude. With an area of about 129,284 square kilometers, this province is the fourth largest province in the country. Yazd is bordered by Semnan and Isfahan provinces from the north and west, Khorasan Razavi province from the northeast, Kerman and South Khorasan provinces from the east, Fars province from the southwest, and Kerman from the southeast. Yazd province has 11 counties, 21 cities, 21 districts and 45 villages according to the latest changes in the country's divisions in 2016.

The studied area is located in the western part of Yazd and is shown in Figure (1).

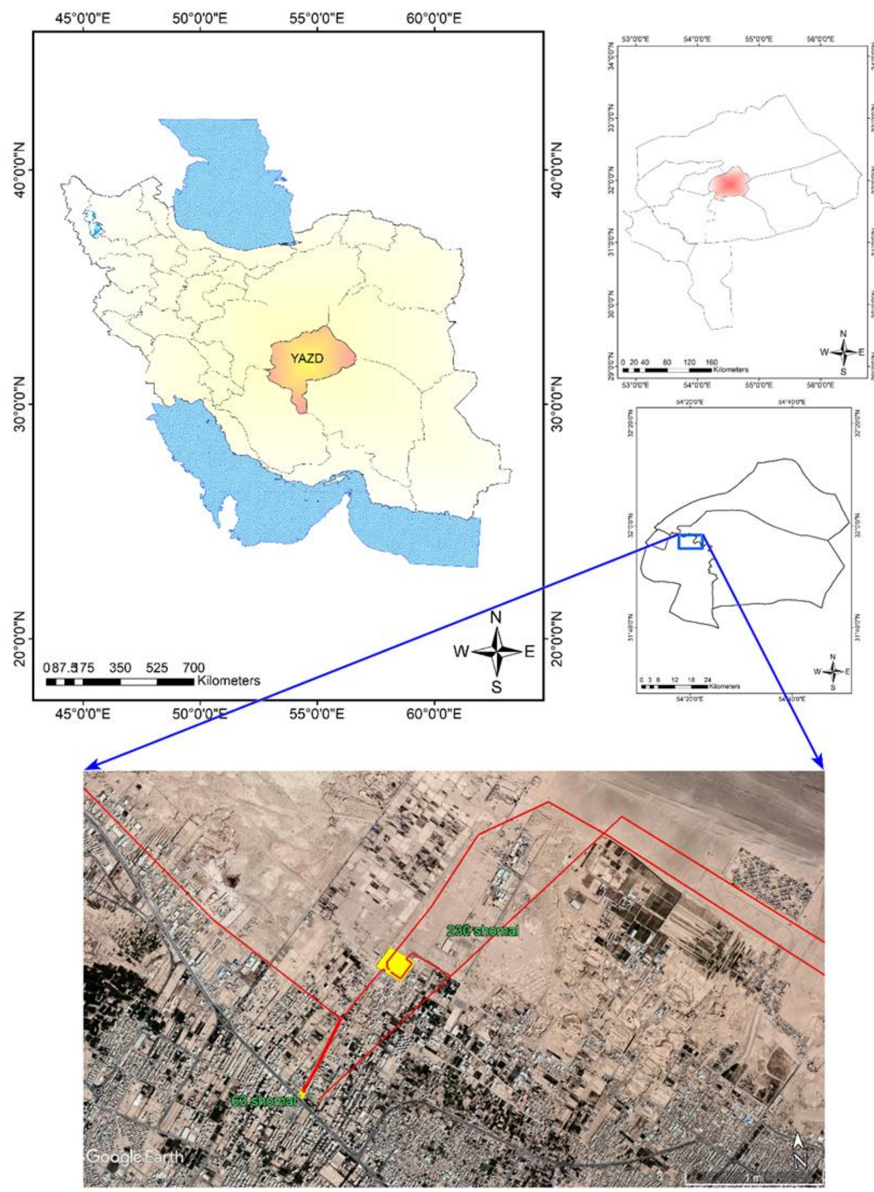

Figure 1. Study area

2.2. Satellite Data Used

In this research, the radar data of Sentinel 1 satellite has been used. The orbit of this polar satellite is Khursheed Anga and is located at an altitude of 693 km from the earth's surface. This sensor has the ability to acquire radar image in the form of dual polarization VH, VV and HV, HH. Therefore, if both platforms of Sentinel 1 are used, the time resolution, or in other words, the visit of Sentinel 1 will reach 6 days. The angle of incidence of this meter is 29.1 to 46 degrees. The Sentinel 1 sensor will image the Earth's surface in four modes. These four modes are: SM mode, IW mode, EW mode and WM7 mode.

Table 2. Different models of Sentinel-1 image collection (Source**:** Sentinel-1 User Handbook, 2013: 34)

Resolution	Polarization	harvest width	user	Image type
5*5	HH+HV,VH+VV,HH,VV	80 KM	Emergency management	*SM*
5*20	HH+HV,VH+VV,HH,VV	250 KM	ground review	IW
20*40	HH+HV,VH+VV,HH,VV	400 KM	Marine applications	EW
5*5	HH,VV	20*20 KM	Open oceans	WV

2.3. Methodology

In this research, for quick and low-cost estimation, in monitoring the status of masts and boundaries of electricity transmission and super-distribution lines and identifying constructions encroaching on electricity boundaries, from the time series analysis of Sentinel 1 satellite radar images in the period from 05/22/2021 to 05/29/2022 which is presented in VH polarization mode was used, after applying the necessary pre-processing in SNAP 8.0 software, in order to extract the zero sigma dispersion coefficient of the images and make them binary, first 100 sample points were sampled as a statistical population from the Landsat images. After performing statistical analysis and calculating the average of two images, the construction threshold limit of two images was calculated and the number 0.081003 was obtained as the construction threshold limit, which identifies the constructions with 85% to 90% accuracy. After determining the threshold, the construction pixels in the images were identified using the fuzzy logic based pixel method and the images were classified., And in the last stage, by creating the privacy layer of the transmission and super-distribution network according to Tavanir's executive regulations and guidelines and overlaying it with fuzzy images, the amount of interference of complications and constructions with the privacy structure of the network was investigated and identified. Also, in order to identify illegal constructions during one year, by using pixel-based algorithm and applying mathematical operations, the fuzzy images of two years were subtracted and the difference of the images was obtained, and illegal constructions in privacy were identified during one year, and at the end, drone images were used to verify the validity of illegal constructions. the results of this research indicate that most of the illegal constructions can be identified semi-automatically with the accuracy of 85-90% using the presented method and And It increased the speed in identifying illegal constructions in privacy and made the visits of privacy experts and the legal unit more targeted.

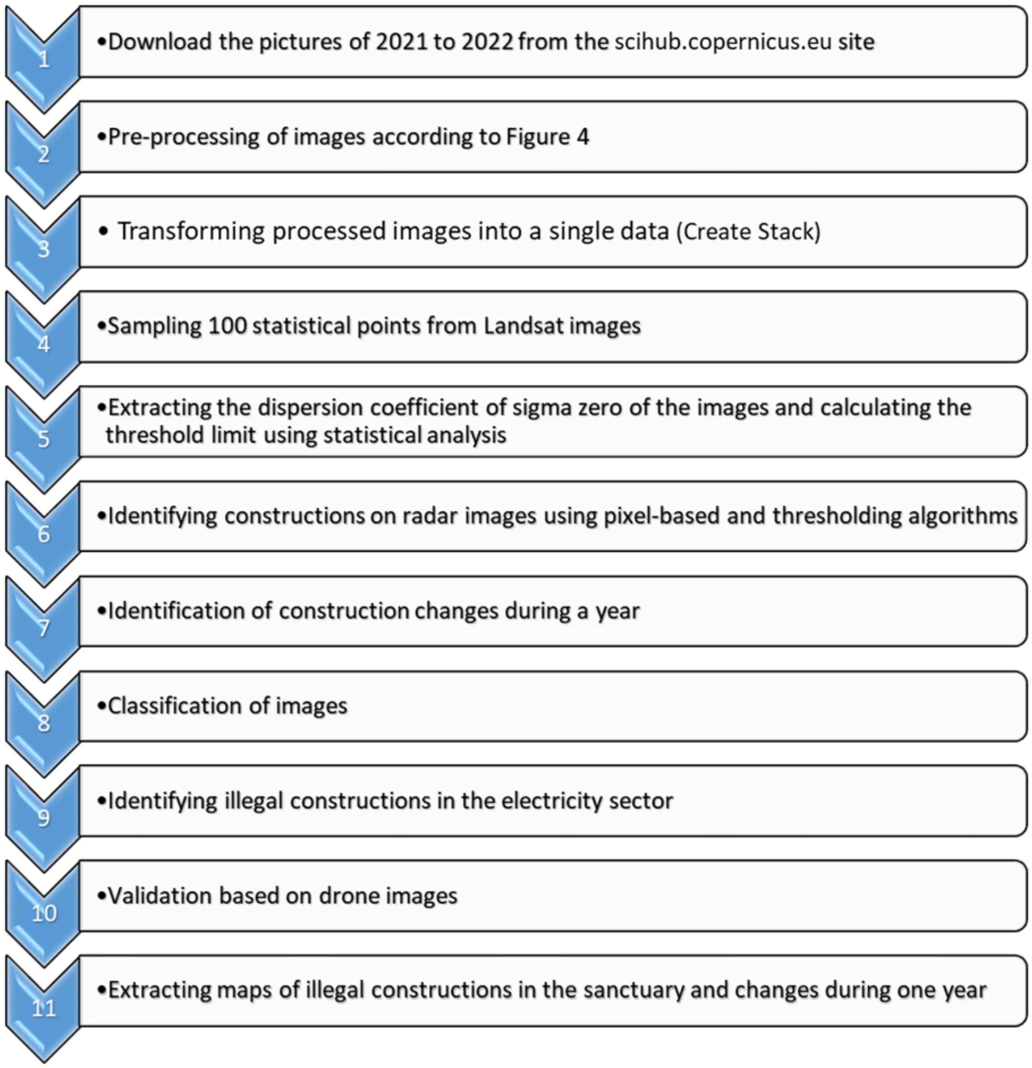

Figure 2. Flowchart of research implementation steps

3. Data Analysis Method

3.1. Loading Satellite Images

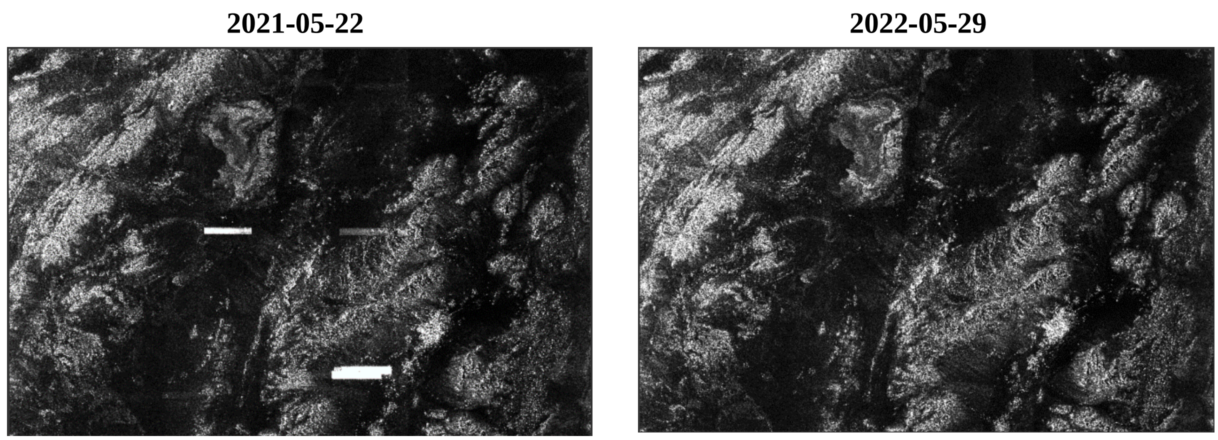

Figure 3. Images downloaded from Sentinel 1 satellite

3.2. Sentinel 1 Images Processing

First, the images were cut according to the desired area with the Subset tool, and then we used the pre-processing steps including geometric corrections and removing radiometric and topographical errors for the images of two years using the Graph Builder tool, where all the steps were designed in the form of a flowchart. The steps were executed and saved for each image.

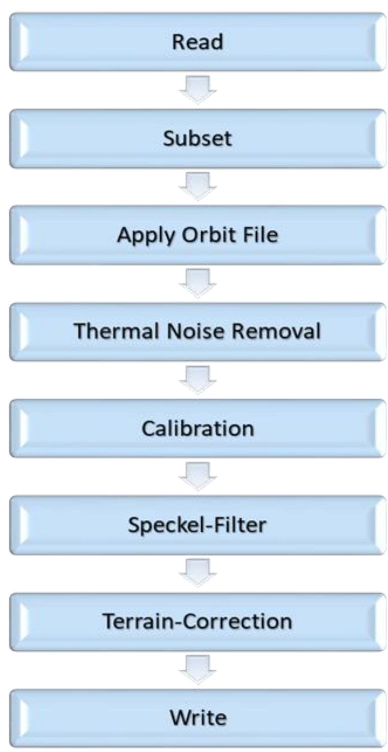

Figure 4. Flowchart of Sentinel 1 image preprocessing steps

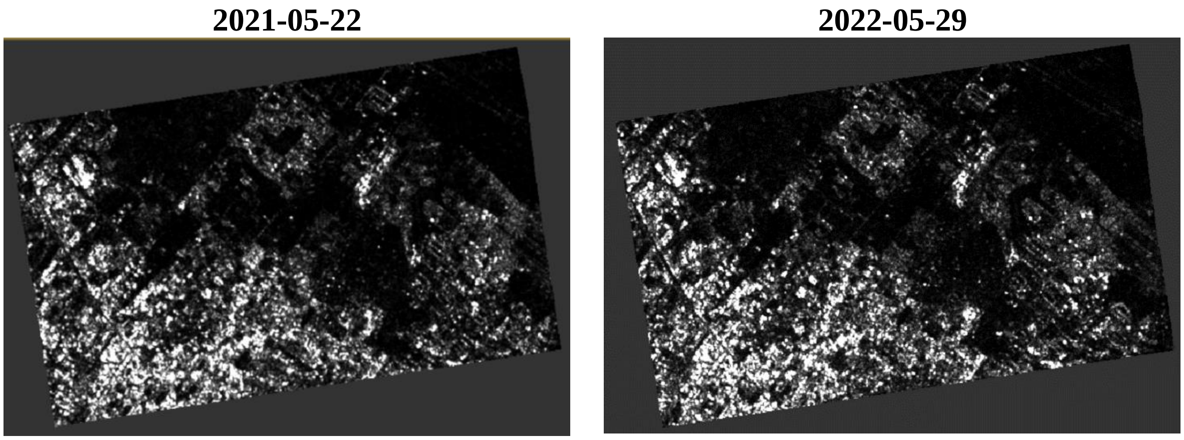

Figure 5. Processed images 2022-2021

3.3. Sampling from Landsat Images

After the corrections made on the images, in order to extract the zero sigma dispersion coefficient of the images and binarize them, 100 sample points were taken as a statistical population from the Landsat images, which include all types of constructions (clay and mud, stone, cement, isogham, silo, etc.,).

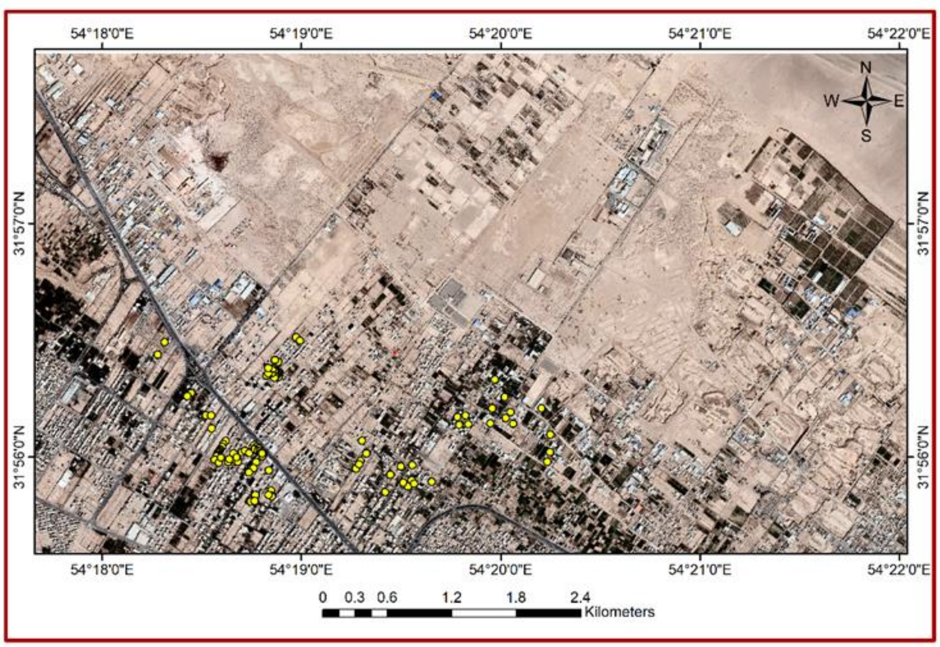

Figure 6. Sampling from Landsat images

3.4. Extracting the Zero Sigma Dispersion Coefficient of the Images

After taking the sample points from Landsat images, since the resolution of Landsat images is 30 meters and Sentinel images is 10 meters, in order to eliminate the error caused by the georeference of the two images and the displacement of the features relative to each other, and to be able to correctly identify the constructions, we created a 30 m buffer for 100 sampled points.

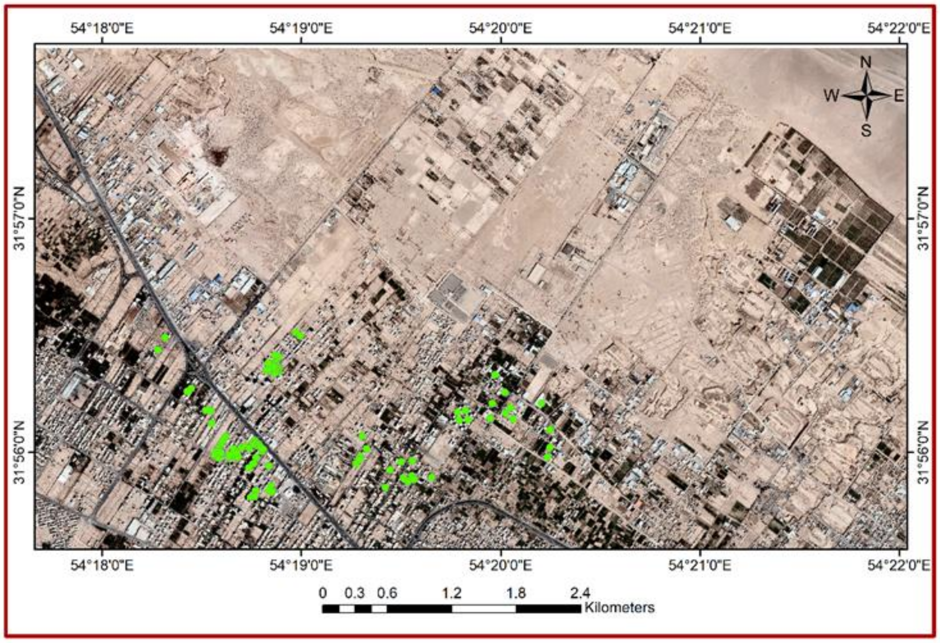

Figure 7. 30 m buffer for 100 sampled points

Since it is very effective to use statistical methods to understand the influence of determining factors and to avoid wasting time and money in the research process (Masoumi et al., 2014), therefore using Zonal Statistics functions in ARCGIS software, statistical analyzes were calculated on the buffers of two images and Min, Max, Mean, Standard Deviation and Variance values were obtained for 100 records, and then the Max average (which is the maximum value of the pixels of a buffer) was calculated for 100 buffers in each image, and a value of 0.082 was obtained for the 2021 image and 0.081 for the 2022 image, and then to obtain the construction threshold limit of the two images, the average of the two images was calculated, and the number 0.081003 was obtained as the construction threshold limit. It was found that this threshold value identifies constructions with an accuracy of 85% to 90%.

	OBJECTII	OBJECTII	COUNT	AREA	MIN	MAX	RANGE	MEAN	STD	SUM	
2	5	5	29	2900	0.00378	0.018165	0.014385	0.010378	0.004117	0.300953	0.019
3	90	91	28	2800	0.005763	0.037352	0.031589	0.014117	0.007666	0.395263	0.038
4	69	70	28	2800	0.006807	0.040357	0.03355	0.020557	0.008771	0.575601	0.041
5	80	81	26	2600	0.009621	0.042584	0.032963	0.022794	0.010276	0.592647	0.043
6	33	33	6	600	0.021378	0.045954	0.024576	0.032623	0.00826	0.195741	0.046
7	55	56	2	200	0.028587	0.046054	0.017467	0.03732	0.008733	0.074641	0.047
8	91	92	26	2600	0.006367	0.048611	0.042244	0.021034	0.010801	0.546885	0.049
9	46	47	16	1600	0.001892	0.05118	0.049289	0.024274	0.015846	0.388387	0.052
10	39	39	2	200	0.04068	0.066897	0.026217	0.053789	0.013108	0.107577	0.067
11	70	71	23	2300	0.005726	0.068386	0.06266	0.022611	0.016102	0.520043	0.069
12	58	59	7	700	0.009104	0.071661	0.062558	0.033317	0.019558	0.23322	0.072
13	3	3	27	2700	0.003602	0.072312	0.06871	0.033103	0.018768	0.893794	0.073
14	35	35	9	900	0.057768	0.081274	0.023507	0.072055	0.007818	0.648494	0.082
15	32	32	10	1000	0.023971	0.082106	0.058135	0.04995	0.018455	0.4995	0.083
16	83	84	29								
17	26	26	7								
18	6	6	30								
19	8	8	18								
20	78	79	27								
21	38	38	7								
22	2	2	32								

2021h | 2022h | aver2021h

	OBJECTII	OBJECTII	COUNT	AREA	MIN	MAX	RANGE	MEAN	STD	SUM	
2	91	92	26	2600	0.004484	0.036384	0.0319	0.01996	0.00835	0.518953	0.037
3	90	91	28	2800	0.005158	0.04325	0.038092	0.022427	0.010233	0.627963	0.044
4	92	93	17	1700	0.014265	0.048859	0.034593	0.030428	0.011018	0.517281	0.049
5	80	81	26	2600	0.012094	0.05218	0.040085	0.021721	0.009	0.564734	0.053
6	33	33	6	600	0.022087	0.052911	0.030823	0.033051	0.011502	0.198305	0.053
7	46	47	16	1600	0.003218	0.064227	0.06101	0.028241	0.017697	0.451849	0.065
8	69	70	28	2800	0.008791	0.066699	0.057908	0.030113	0.014996	0.843172	0.067
9	5	5	29	2900	0.00997	0.066787	0.056817	0.026976	0.013101	0.782298	0.067
10	58	59	7	700	0.025351	0.070386	0.045034	0.038217	0.014448	0.267518	0.071
11	38	38	7	700	0.03353	0.071458	0.037929	0.0475	0.013495	0.332498	0.072
12	70	71	23	2300	0.004241	0.072357	0.068115	0.034909	0.016398	0.802916	0.073
13	3	3	27	2700	0.00332	0.074432	0.071112	0.031474	0.020806	0.849786	0.075
14	27	27	26	2600	0.013292	0.077723	0.064431	0.040637	0.017238	1.056567	0.078
15	55	56	2	200	0.053901	0.078586	0.024685	0.066244	0.012342	0.132488	0.079
16	6	6	30	3000	0.001368	0.080732	0.079364	0.025957	0.02268	0.778705	0.081
17	49	50	6	600	0.014469	0.082657	0.068188	0.031661	0.023338	0.189966	0.083
18	26	26	7	700	0.013507	0.083017	0.06951	0.047191	0.023249	0.330336	0.084
19	8	8	18	1800	0.029867	0.089718	0.059851	0.054226	0.015196	0.97606	0.09
20	32	32	10	1000	0.033603	0.096038	0.062436	0.053931	0.021204	0.539306	0.097
21	2	2	32	3200	0.006494	0.098479	0.091985	0.045698	0.024918	1.462324	0.099
22	96	97	28	2800	0.01721	0.10453	0.08732	0.046467	0.022399	1.301087	0.105

2021h | 2022h | aver2021h | aver2022h | Sheet3

Figure 8. Calculate the average threshold limit

3.5. Production of Images and Maps of Constructions

After the threshold limit was determined, the following condition was placed on the first image (2021) with the Band Maths command to determine the building boundaries in the SNAP software:

if Sigma0_VH>0.081003 then 1 else 0

2021 2022

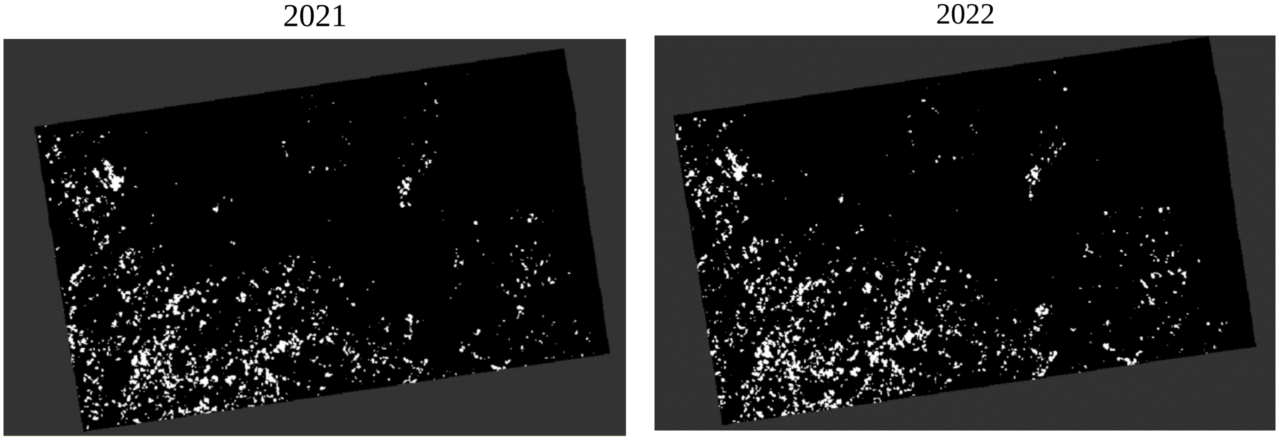

Figure 9. Identification of constructions on radar images with pixel-based algorithm

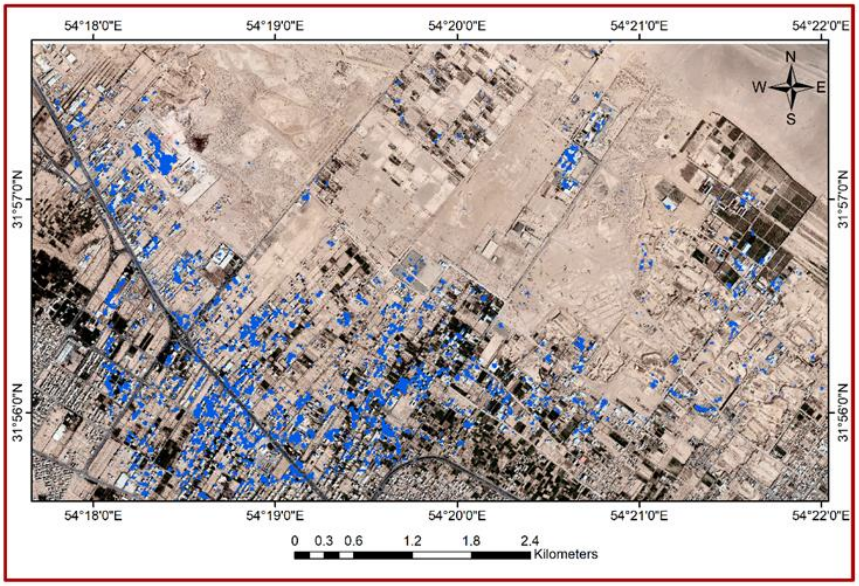

Figure 10. Construction map for 2021

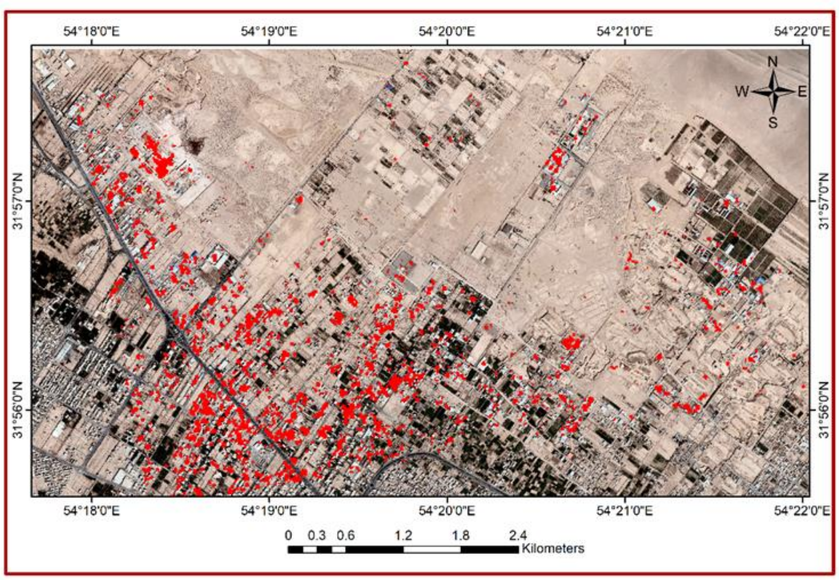

Figure 11. Construction map for 2022

3.6. Production of a Maps of Changes in Constructions in a Period of One Year

After the construction areas were separated, to calculate the changes made in a one-year period and the difference between the images of one year, using the algebraic method and applying mathematical operations, the second phased image, which is related to the constructions of 2022, was separated from the constructions of the image related to the year 2021 using the Time2-Time1 formula and the result can be shown in the image below.

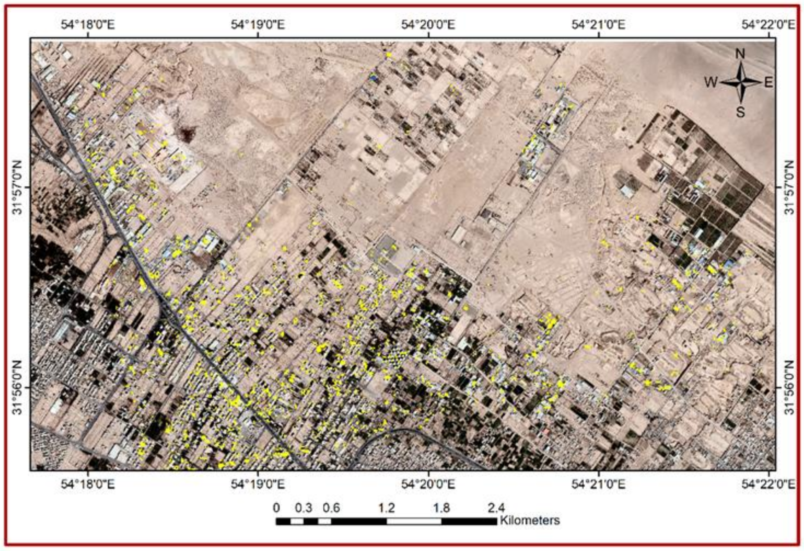

Figure 12. Construction changes during a year

3.7. Identifying Illegal Constructions in Privacy

At this stage, by creating privacy from the network of transmission and super distribution lines of Yazd province according to Tavanir's executive guidelines and overlaying it with fuzzy images, the level of interference of side effects and constructions with the privacy structure of the network was identified.

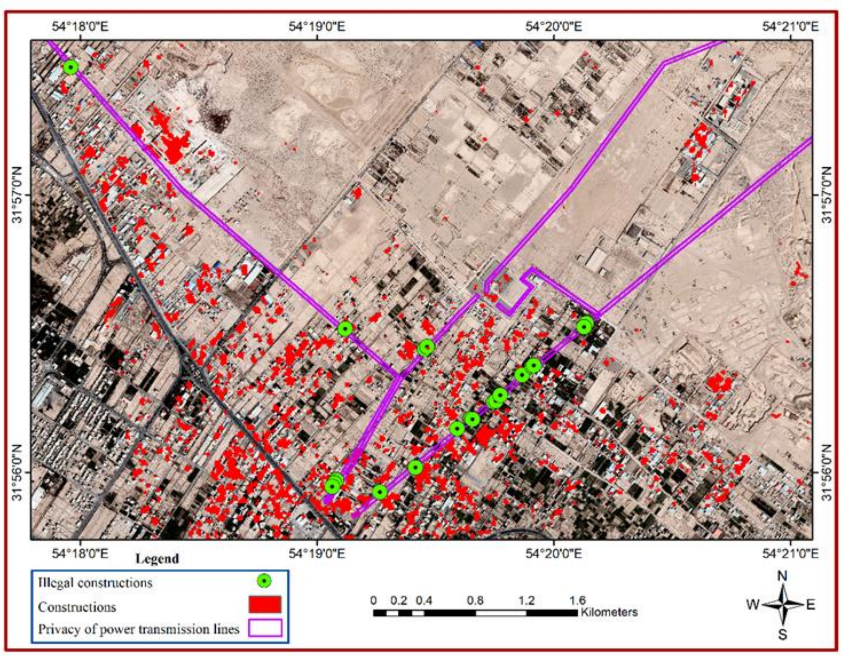

Figure 13. The map of illegal constructions in the electricity sector until 2022

Then, in order to obtain the illegal constructions in privacy in a period of one year (2021 to 2022), the transmission and super distribution line of privacy with the image of construction changes during a year that was fuzzy, Overlay was done and the illegal constructions in privacy during this one year is identified.

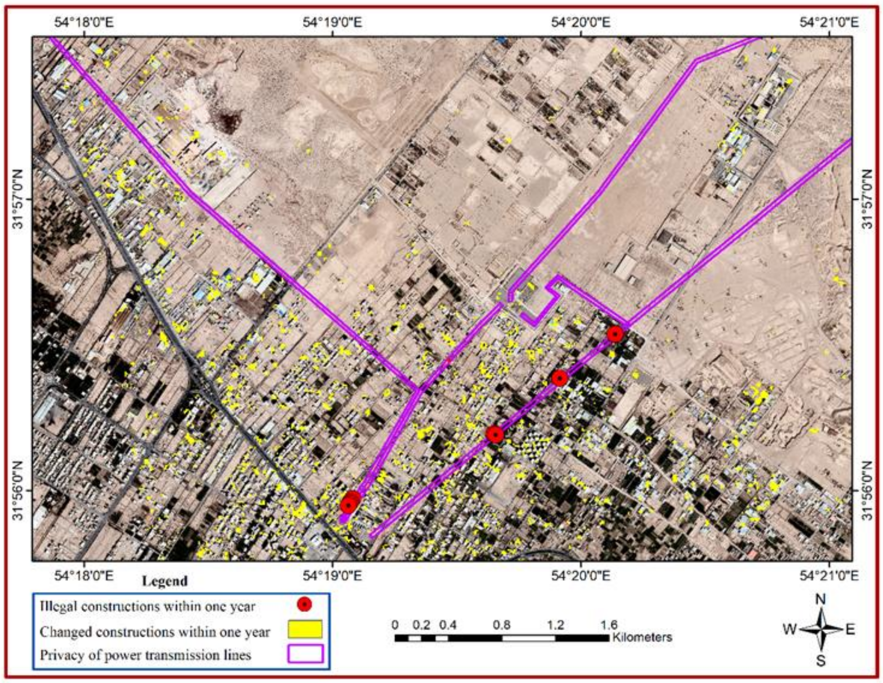

Figure 14. Map of illegal constructions in the electricity zone during one year (2021-2022)

3.8. Validation

Validation of Construction Changes During One Year

In this part, drone and Google Earth images were used to ensure the correct identification of construction changes during one year, and some examples of these changes are shown below.

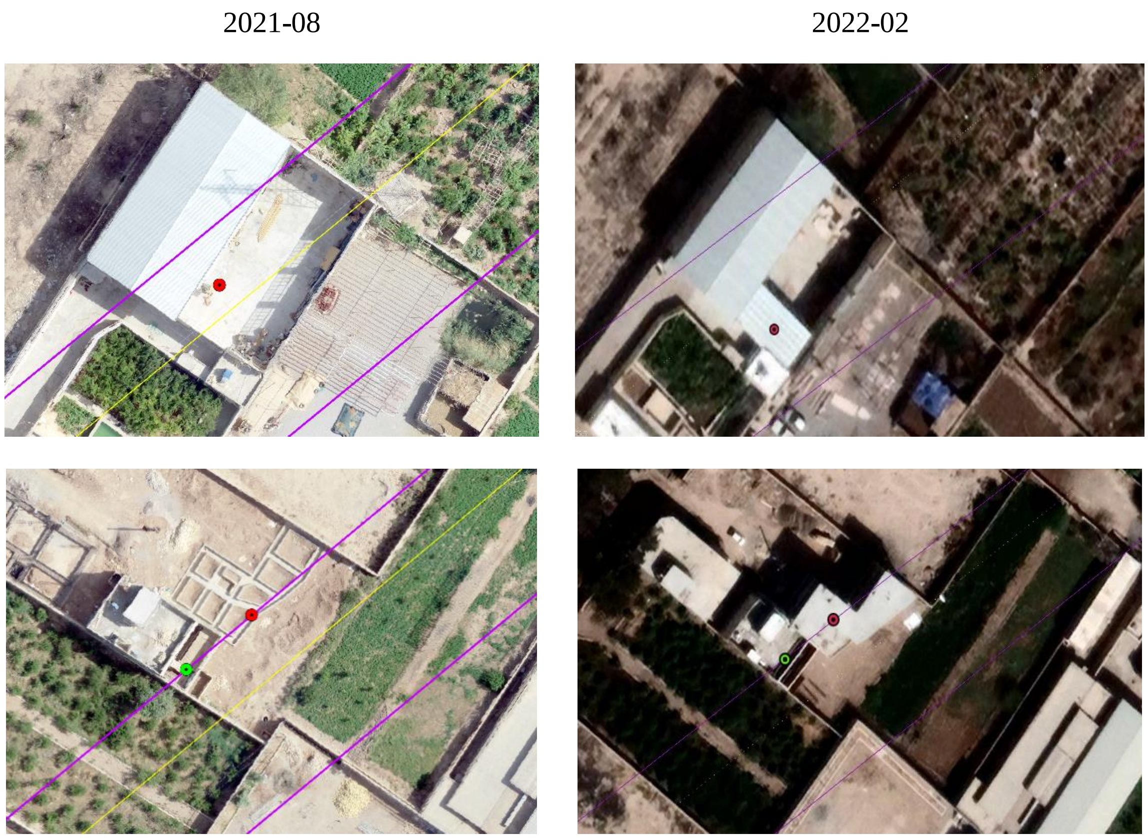

Figure 15. Construction changes during a year

Validation of Illegal Constructions in Privacy

In the end, drone images were used to verify and ensure accurate identification of illegal constructions in privacy.

Figure 16. Construction changes during a year

4. Examining Research Hypotheses

1. The use of remote sensing and radar data of Sentinel 1 satellite is suitable for revealing the limits of violation of the privacy of transmission and super distribution lines and semi-automatic monitoring analysis.

Considering the advantages of radar technology, such as imaging in any type of weather, the possibility of passing through water and dust, fog, the ability to penetrate into the soil, vegetation and snow, free access to Sentinel 1 images in the C band of radar to imaging It covers the surface of the earth and provides an acceptable resolution up to 5 meters and a coverage of 400 km. This satellite is also designed to have non-stop imaging of all regions of the planet in an operational mode.

2. The use of semi-automatic monitoring technique is capable of predicting and monitoring unauthorized constructions and trespassing on the privacy of transmission lines with high accuracy.

The results of this research indicate that the speed and accuracy achieved in image classification, identification of illegal constructions in privacy and identification of changes made in the boundaries of privacy within a period of one year are significant compared to other techniques in relation to monitoring illegal constructions. According to the results of this research, the overall accuracy for identifying illegal constructions in privacy can be declared as 85-90%.

3. The use of semi-automatic monitoring technique in identifying illegal constructions in privacy saves time and money compared to traditional methods.

The current method of monitoring the privacy of lines and constructions adjacent to the privacy, which is used in Iran, is based on the presence of privacy experts and manual inspection of the lines. Manual inspection of transmission lines as a traditional method has obvious disadvantages such as long inspection cycle, low efficiency and very expensive work. Since many lines are located in the suburbs or even uninhabited areas, manual line inspection requires a long journey to get there, and when it comes to special terrain and weather conditions, it often leads to low inspection efficiency and safety. It does not always guarantee personnel, or some current surveillance techniques use unmanned aerial vehicles (UAVs) and aerial photography as monitoring tools, however, these methods are expensive and impractical for monitoring large areas. Bringing multi-time satellite images and using image processing techniques for automatic change detection is one of the optimal methods that can be used in monitoring illegal constructions.

5. Results and Discussion

Monitoring the privacy of electricity and monitoring illegal constructions in the privacy of electricity transmission lines is a relatively new issue. However, in this research, a new method based on the pixel-based pattern and algebraic method was presented to identify illegal constructions in the electricity zone by using two-time satellite images, maps and the zone layer of the power transmission line network in the study area, and with its help, 85 to 90% of the illegal constructions in the study area were identified. Illegal constructions in this research caused the hypothesis of this research to be proven, which means that it is possible to semi-automatically monitor and monitor illegal constructions in the territory by means of Sentinel Series 1 radar image processing techniques and the required data, with the least presence of human agents and in a shorter time. has it.

The results of this research indicate that most of the illegal constructions can be semi-automatically identified using the presented method and increase the speed in identifying the constructions that violate the privacy and by focusing more experts on the identified areas, it reduced costs in face-to-face visits And finally, with a targeted field visit, he ensured the correctness of the results obtained in the shortest possible time.

This means that with the identification of illegal constructions, their location is also identified and reported to privacy experts so that they can remove suspicious complications in the shortest possible time. Therefore, the use of the presented semi-automatic method clearly reduces the time of identifying illegal constructions and helps to prevent the continuation of such constructions and fulfills the objectives of this research. As a result, satellite monitoring can become an important maintenance planning tool for power companies in the near future.

The presented method is generally general and can be used in other metropolises and cities of the country. But the use of two-time satellite images that were taken at noon and with a short period of time will minimize the error of the images. Because it causes the shadow effect to be minimized and the imaging is done under the same exposure conditions. In addition, by using satellite images with higher spatial resolution, higher accuracies in identifying illegal constructions will probably be achieved, and in areas of the city where most buildings are newly built, the accuracy of identifying constructions will increase to 95%.

6. Conclusion

The most important results of this research can be listed as follows:

- The use of time series analysis makes accurate calculation of the changes made in different time periods.
- The use of Sentinel Series 1 satellite radar images is recommended due to its acceptable resolution and high coverage, easy and free access, imaging capabilities in any type of weather, fast processing, and high overall accuracy.
- The use of the presented semi-automatic monitoring technique will obviously reduce the time to detect illegal constructions and help prevent such constructions from continuing.
- The use of multi-temporal satellite images that were taken at noon and with a short period of time will minimize the error of the images; Because the shadow effect is minimized and the imaging takes place under the same exposure conditions.
- Using this technique, in addition to speeding up the process of monitoring the privacy and preventing illegal constructions in the privacy, it also prevents damage and financial losses to electrical equipment and increases the safety of maintenance personnel.
- Management and planning of monitoring as best as possible with minimum cost and time
- Minimizing field visits and targeting the visits of privacy experts
- Increasing the accuracy of identifying constructions in new areas of the city

7. Recommendation

Suggestions Since the issue of electricity privacy is related to the construction in the vicinity of power lines, constructions in the vicinity of electricity privacy should be avoided in the first place. The legal distance for high pressure lines in the cities is based on the Tavanir standard, which must be observed during the construction of the building. This privacy can be considered in three ways: 1- The grid should be moved, 2- The building should be built further back, 3- The grid should be moved, and the property should be built further back. This discussion is under the title of the discussion of the removal of privacy. It is suggested to prepare and present an executive model to implement this model in executive devices that are not able to use the complete system. In the topic of respect for privacy, in addition to lateral privacy, height privacy should also be considered, for this purpose, 3D modeling of area complications can provide very useful information to users. Therefore, it is suggested to prepare the three-dimensional structure of urban areas and tolls, such as electricity transmission and super-distribution networks, which make it possible to understand many environmental realities (Zargar and Meghridi, 2011).

In today's era, due to urban development and the increase in urban population, the need for electricity transmission networks is increasing day by day, and we need a suitable and optimal design for electricity transmission. Currently, the construction of electricity transmission lines in the country is contrary to the laws and regulations related to the design of transmission lines and is also contrary to environmental issues (Amini, 2020) and it will have harmful effects on humans and the environment, and for this reason People who are exposed to the passing currents of power transmission lines are more likely than others to get various cancers, so to avoid the dangers and problems of power transmission lines, one of the proposed solutions is to use underground power transmission lines instead of overhead power transmission lines. is. Underground electricity transmission is the best solution to solve the problems in overhead power transmission lines, which of course, along with the advantages, may also have disadvantages, for example, the cost of its implementation will be higher than the aerial method, but it is one of the suitable infrastructures of the country, which If it is built and operated for many years, the country and its citizens will enjoy its benefits.

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