**Jurnal ELTIKOM:**
**Jurnal Teknik Elektro, Teknologi Informasi dan Komputer**

Vol. 7, No. 2, December 2023, page. 192-199
ISSN 2598-3245 (Print), ISSN 2598-3288 (Online)
DOI: http://doi.org/10.31961/eltikom.v7i2.573
Available online at http://eltikom.poliban.ac.id

# FAST PREDICTION OF MEDIUM VOLTAGE NETWORK DISTURBANCES USING KNOWLEDGE GROWING SYSTEM (KGS) METHOD

**Ika Noer Syamsiana[1], Puspa Ayu Yohana[2*], Indrazno Sirajuddin[2], Arwin Datumaya Wahyudi Sumari[1], Andhika Sulistio[2]**

1) Electrical Engineering, Politeknik Negeri Malang, Malang, Indonesia
2) Electrical Engineering, Politeknik Negeri Banjarmasin, Banjarmasin, Indonesia
e-mail: ikanoersyamsiana@polinema.ac.id, puspaayuyohana@gmail.com, indrazno@polinema.ac.id, arwin.sumari@polinema.ac.id, andhikasulistio16@gmail.com

Received: 3 June 2022 – Revised: 12 January 2024 – Accepted: 12 January 2024

***ABSTRACT***

*With the increasing demand for electrical energy in the household and industrial sectors, reliability in the distribution of electrical energy is very important. Disturbance in electricity distribution is a routine problem that will always occur in the field. To improve the quality of service, readiness in overcoming distribution disturbances is needed, for example by knowing the disturbances that will occur in the field. This study was conducted to solve this problem by applying the Knowledge Growing System (KGS) method in predicting the type of electricity distribution disturbance that occurred in the PLN unit. In this study, the scope of the research object is limited to PLN units in the South Surabaya area. This prediction is done by recognizing the pattern of disturbances that occur every month based on data taken in 2020. This method was chosen because it is an intelligent agent that can generate its knowledge through observing certain phenomena so that it can produce its own knowledge in making predictions. In this study, 5 patterns of electrical disturbances were used at the location of the electricity distribution. From the results of calculations and analysis using the KGS method, it was found that the prediction of electrical distribution disturbances in the form of animal disturbances with the highest degree of confidence value (DoC) occurred at the Sukolilo substation of 34.77%. Predictions of other disturbances in the form of "material" disturbances occur in Rungkut, Waru, and Darmo Grand feeders with DoC values of 28.33%, 29.72%, and 34.72%, respectively.*

***Keywords****: fast fault predictor, intelligent agent, Knowledge Growing System, power distribution fault*.

## I. INTRODUCTION

ACCURACY and speed in making a decision in a particular situation is a challenge, especially in critical systems, such as electrical systems. In electricity distribution, the problem of disruption of the electricity distribution network must be handled quickly and appropriately because this will have an impact on the reliability of electricity supply to consumers [1]. Based on PLN statistical data, the number of disturbances throughout Indonesia in 2020 was 47,443 times. This shows that the handling of electricity disturbances in Indonesia is still at a less reliable level. Power outages often occur either intentionally due to maintenance or due to disturbances, which can have an impact on equipment damage, especially in the industrial sector which can disrupt the production process. In addition, disturbances that occur can also harm PT PLN (Persero) as a provider of electrical energy and consumers, especially if there is a blackout for a relatively long period of time. Therefore, the handling of these disturbances needs to be done quickly and precisely in order to prevent losses for both parties [2]–[4].

In an effort to anticipate the possibility of future interference, a predictive system is needed that is able to predict interference based on available interference pattern data. One technology that is often used in forecasting is artificial intelligence (AI) technology, such as machine learning [1], [5]–[7] fuzzy [8], or combination with artificial neural networks, or using statistics. In 2009, a new prediction method in artificial intelligence was discovered which was later called Knowledge Growing System (KGS) [9], [10]. KGS is a cognitive artificial intelligence or cognitive agent-based system that is able to grow its own knowledge over time by utilizing more and more information to be extracted into knowledge as a basis for decision making. KGS has been used in various problems, such as dynamic prediction of the COVID-19 pandemic in Java, prediction of transformer health conditions, prediction of maritime security, and for predictions in other applications. Based on various prediction problems using KGS, this technique is considered capable of predicting electricity distribution disturbances, so it was chosen to be tested to ensure that the prediction results obtained previously can be tested properly [5], [11]–[13].

Research on electricity load prediction using artificial intelligence has been widely conducted. Among them are predicting electricity loads on the island of Bali using Backpropagation Neural Networks and forecasting short-term electricity loads on East Java and Bali electricity systems using fuzzy time series. The use of artificial neural network methods in predicting electricity load has several disadvantages, such as only producing one output value. Meanwhile, the use of the fuzzy inference system method has a disadvantage, namely the need for an optimization method in determining the parameters used [16], [17].

In the KGS method, knowledge growth runs in a cycle of sensing, inference, and formulation of Decisions and Actions (PIKT) based on the fusion of inference-information, Multi-Time Observation, A3S, the quality of knowledge grown is measured using the parameter of Degree of Certainty (DoC) [5], [14]. The A3S method has been refined into the ASSA2010 method [11], [15].

The availability of information on predicting electricity distribution disruptions will be able to increase readiness in anticipating electricity distribution disruptions that occur. Prediction of this disturbance can be obtained by processing information data from previous electrical load disturbances. To process the data, the right prediction technology is needed to process the data. In this study, predictions of electricity distribution disturbances were carried out using KGS applied in the South Surabaya area.

## II. RESEARCH METHOD

### *A. KGS (Knowledge Growing System)*

Processing information can be done very easily by the human brain. Any kind of information including images, text, sounds, and tastes coming from human sensory organs can be processed in just a very short time. The output of the process or the information processed can be used as decision-making material or for subsequent processes.

The concept of KGS was born as an effort to create a system that can imitate the human way of thinking, namely obtaining as much knowledge as possible from the environment so that it can act rationally. The KGS concept wraps two perspectives to create intelligent systems, namely systems that carry the characteristics of human intelligence. Therefore, we can say that KGS is a new perspective in AI. In simple terms, we define KGS as a system that has the ability to develop its knowledge as it increases the knowledge it receives over time [2]. KGS is a system that can think humanly to take rational actions. For example, at time $t_0$ is assumed to be when no information is obtained. Then, at time $t_0$, we try to find out by utilizing our 5 sensory members, namely eyes, nose, ears, tongue, and skin. At $t_1$, the eyes will see and convey information to the brain, but the brain still cannot conclude what phenomenon is conveyed. Then, at $t_2$, our skin comes into contact and conveys information to the brain. This process will continue until $t_n$ or until the brain obtains clear information that can be used to make inferences about new knowledge phenomena.

### *B. A3S Method*

The development of KGS starting from the concept, way of thinking systems and how to get new knowledge, is carried out through approaches from several scientific fields, namely psychology, social, mathematics, management, and electrical engineering and informatics. From psychological science, the Human Inference System model also includes a new decision-making model. From social science, consensus theory is obtained, where there are several formulations to reach agreement, one of which is the Linear Opinion Pool (LOP) which presents the formulation of social decisions. In terms of mathematics, it is developed based on the Bayes Inference Method (BIM) which is considered capable of presenting

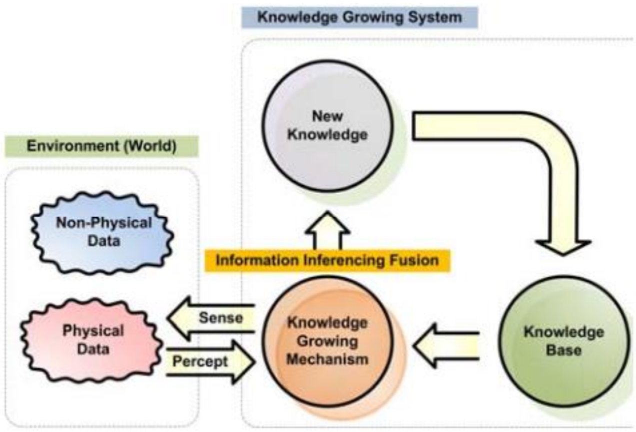


Figure 1. Knowledge Growing System (KGS) Concept

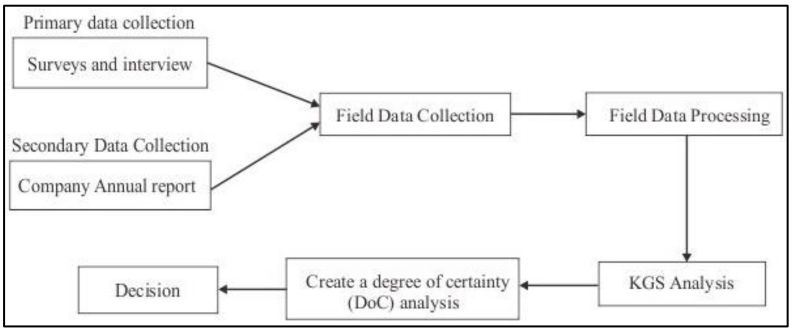


Figure 2. Flowchart of Research Method

the way humans think. However, there are several obstacles in LOP and BIM that have not been able to handle multi-indication and multi-hypothesis phenomena so that a mathematical formula was developed into the A3S (Arwin-Adang-Aciek-Sembiring) method [14].

In conducting this research, the authors used the KGS method which is described in the research flow chart, as shown in Figure 1. This research flow chart starts from a literature study of predictions using KGS, conducting discussions and interviews with related parties, followed by consultation, then collecting data in the South Surabaya Customer Service Implementation Unit (UP3). This data collection is in the form of distribution interference data at 7 substations, namely Rungkut, Waru, Wonorejo, Sukolilo, Ngagel, Darmo Grand, and Wonokromo.

After the data is collected, the data is then processed into KGS input variables. If the data meets the eligibility parameters, then proceed to the KGS analysis calculation process. Conversely, if the data obtained does not meet the eligibility parameters, then the field data processing is carried out again. The KGS Analysis calculation will produce a Degree of Certainty (DoC) value or degree of confidence that can be the basis for decision making to get conclusions in this study. To perform calculations with the A3S method, (1) can be used.

$$P\left(\Psi_i^j\right) = \frac{\sum_{i=1}^{\delta} P(\upsilon_j^i)}{\delta} \tag{1}$$

where $P\left(\Psi_i^j\right)$ is the qualification value for a particular alternative based on certain eligibility parameters. $P(\upsilon_j^i)$ is hypothesis $i$ on indication $j$. $\delta$ is the number of sources of information that observe a phenomenon, in research shows the number of months in one year of observation (12 months)$\delta$. $i$ is an indication that refers to 7 substations by looking at indications of disturbances that occur. $j$ is a hypothesis, hypothesis refers to various disorders.

Feasibility parameters are a list of parameters used as standards in comparing a phenomenon (object, state, situation). Feasibility parameters are an important component of input processing because the system only accepts input in the form of a series of binary numbers '0' and '1' that represent feasibility on the parameters tested. Eligibility parameters will be transferred in the form of matrices $n \times m$ where

TABLE 1
ELIGIBILITY PARAMETERS FOR SELECTION OF SOUTH SURABAYA UP DISTURBANCES DURING DECEMBER 2020 [16]

| No. | Name of Substation | Date | Time of Disruption | Weather | Cause |
|---|---|---|---|---|---|
| 1 | WARU | 02/12/2020 | 23:15 – 23:17 | Bright | Undiscovered |
| 2 | FREE GRAND | 04/12/2020 | 10:54 – 10:58 | Bright | Out of Control |
| 3 | SUKOLILO | 05/12/2020 | 12:55 – 12:59 | Cloudy | Undiscovered |
| 4 | WARU | 05/12/2020 | 15:15 – 16:53 | Wind Rain | Material |
| 5 | RUNGKUT | 05/12/2020 | 15:26 – 16:00 | Wind Rain | Row |
| 6 | WARU | 05/12/2020 | 15:14 – 16:29 | Wind Rain | Undiscovered |
| 7 | WARU | 06/12/2020 | 04:45 – 04:49 | Bright | Undiscovered |
| 8 | WARU | 07/12/2020 | 03:07 – 03:09 | Rain | Undiscovered |
| 9 | WONOREJO | 08/12/2020 | 15:32 – 15:34 | Cloudy | Material |
| 10 | SUKOLILO | 08/12/2020 | 18:02 – 18:04 | Cloudy | Undiscovered |
| 11 | FREE GRAND | 08/12/2020 | 19:39 – 19:42 | Cloudy | Undiscovered |
| 12 | WONOKROMO | 08/12/2020 | 23:15 – 00:00 | Cloudy | Undiscovered |
| 13 | WONOREJO | 09/12/2020 | 15:48 – 16:18 | Rain | Undiscovered |
| 14 | WONOREJO | 10/12/2020 | 07:38 – 08:10 | Rain | Undiscovered |
| 15 | WARU | 10/12/2020 | 01:30 – 01:33 | Rain | Material |
| 16 | FREE GRAND | 10/12/2020 | 13:40 – 14:07 | Wind Rain | Undiscovered |
| 17 | RUNGKUT | 13/12/2020 | 21:56 – 22:54 | Rain | Material |
| 18 | WONOREJO | 16/12/2020 | 12:41 – 13:42 | Rain & Thunder | Material |
| 19 | WARU | 17/12/2020 | 04:33 – 04:36 | Bright | Undiscovered |
| 20 | RUNGKUT | 18/12/2020 | 21:44 – 22:06 | Rain | Out of Control |
| 21 | RUNGKUT | 19/12/2020 | 11:41 – 12:34 | Bright | Material |
| 22 | WONOREJO | 22/12/2020 | 14:02 – 14:04 | Bright | Undiscovered |
| 23 | FREE GRAND | 23/12/2020 | 07:59 – 08:01 | Bright | Animal |
| 24 | WARU | 23/12/2020 | 13:49 – 14:16 | Bright | Material |
| 25 | RUNGKUT | 24/12/2020 | 03:45 – 04:50 | Bright | Animal |
| 26 | RUNGKUT | 27/12/2020 | 19:33 – 19.35 | Wind Rain | Undiscovered |
| 27 | NGAGEL | 27/12/2020 | 20:10 – 20:42 | Wind Rain | Material |
| 28 | RUNGKUT | 27/12/2020 | 20:12 – 22:05 | Wind Rain | Material |
| 29 | WONOREJO | 27/12/2020 | 20:57 – 21.42 | Wind Rain | Material |
| 30 | WONOREJO | 29/12/2020 | 14:13 – 14:15 | Bright | Undiscovered |
| 31 | WARU | 30/12/2020 | 01:45 – 01:47 | Bright | Material |
| 32 | RUNGKUT | 31/12/2020 | 18:09 – 18:26 | Overcast, Lightning | Undiscovered |

TABLE 2
ELIGIBILITY INFORMATION FOR EACH CANDIDATE IMPAIRMENT IN A 12X5 MATRIX TABLE

| Information from Substations | Monthly Disruption | Various Disorders | | | | |
|---|---|---|---|---|---|---|
| | Year 2020 | Material | Animal | Row | Undiscovered | Out of Control |
| Rungkut | January | 1 | 0 | 0 | 0 | 1 |
| | February | 1 | 0 | 0 | 1 | 1 |
| | Maret | 1 | 1 | 0 | 1 | 1 |
| | April | 1 | 1 | 0 | 1 | 0 |
| | From | 1 | 1 | 1 | 1 | 0 |
| | June | 0 | 0 | 0 | 1 | 1 |
| | July | 1 | 1 | 0 | 1 | 1 |
| | Agustus | 0 | 1 | 0 | 1 | 1 |
| | September | 1 | 0 | 0 | 1 | 1 |
| | October | 1 | 1 | 1 | 1 | 0 |
| | November | 1 | 1 | 0 | 1 | 1 |
| | December | 1 | 1 | 0 | 1 | 1 |
| | DPPB value | 0.2833 | 0.1764 | 0.0417 | 0.2736 | 0.2458 |

*n* is the number of eligibility parameters and *m* is the number of candidates. If we have determined the feasibility parameter, the DPPB value will appear where the DPPB value is what shows the phenomenon of knowledge growth in KGS. In this study, the feasibility parameter determined was the type of disturbance that occurred in UP3 South Surabaya by taking disturbance data at 7 substations for a year with disturbances in December 2020 in Table 1.

After comparison with eligibility parameters, feasibility information was obtained in the form of numbers '0' and '1'. The number '0' indicates no disturbance while the number '1' indicates a disturbance that occurred as shown in Table 2 with samples of the Rungkut substation.

An application of the A3S method that returns the DPPB value with (1) is shown in the last row of Table 2. Before doing calculations, there are two important things that must be considered, namely in the row there must be at least one information number '1', if all information contains the number '0' then

TABLE 3
ILLUSTRATION OF THE A3S METHOD

| To | | Ai is multi-hypothesis<br>Material, Animal, Row, Undiscovered, Out of Control | | | | |
|---|---|---|---|---|---|---|
| *Bj* | | 1 | … | *i* | … | *n* |
| *Bj*,<br>Multi Indication<br>(7 Substations with daily data) | 1 | $P(\vartheta_1^1)$ | … | $P(\vartheta_1^i)$ | … | $P(\vartheta_1^n)$ |
| | 2 | $P(\vartheta_2^1)$ | … | $P(\vartheta_2^i)$ | … | $P(\vartheta_2^n)$ |
| | … | … | … | … | … | … |
| | *j* | $P(\vartheta_j^1)$ | … | $P(\vartheta_j^i)$ | ... | $P(\vartheta_j^n)$ |

the data row cannot be included in computing because it does not meet the requirements. If the information for all candidates is incomplete, then the information on that line should be ignored. To facilitate understanding in processing DPPB values, see the illustration in Table 3. Therefore, if put into a formula that uses the A3S method with a sample on the material hypothesis, it can be calculated as 0.2833.

### C. Determination of DPPB Candidates

The next step is to determine the candidate with the highest probability value in the DPPB using (2).

$$P(\Psi)_{estimation} = \odot\left[P(\Psi_j)\right] \quad (2)$$

where $P(\Psi)_{estimation}$ shows the estimated value of the knowledge obtained by KGS from each candidate disorder, while the symbol $\odot$ indicates the operation operator to obtain the highest value of the total probability addition operation after knowing the actual situation as the best estimate of the multi-hypothesis to be selected [15]. $\Psi_j$ is the probability of the DPPB value. So that with the same sample at the substation Rungkut the value will be obtained using (3). Therefore, a value of 0.2736 is obtained.

$$\begin{gathered} P(\Psi)_{estimasi} = \odot\left[P(\Psi_j)\right] \\ P(\Psi)_{estimasi} = \odot\,[0.2625; 0.1764; 0.0417; 0.2736; 0.24558] \\ P(\Psi)_{estimasi} = 0.2736 \end{gathered} \quad (3)$$

### D. Degree of Confidence (DoC)

The next step is obtaining the DoC value, where the DoC or degree of confidence presents the confidence value of the choice that is most considered appropriate according to KGS knowledge. This knowledge is used as a basis for decision making to make choices, by calculating the degree of confidence that will obtain what percentage of interference occurs in the medium voltage distribution network of the Surabaya area. DoC is obtained by calculation according to (4)

$$\begin{gathered} \mathrm{DoC} = \left|\mathrm{P}(\Psi)_{\mathrm{estimasi}} - \mathrm{P}\upsilon_1^{\mathrm{j}}\right| \mathrm{x}\ 100\ \% \\ \mathrm{DoC} = |0.2736 - 0|\ \mathrm{x}\ 100\ \% \\ \mathrm{DoC} = 27.36\ \% \end{gathered} \quad (4)$$

where $\mathrm{P}\upsilon_1^{\mathrm{j}}$ is the initial knowledge of the system when it has not received any information. The calculation results show that the Degree of Contamination (DoC) value of the Rungkut Substation sample is 27.36%. Therefore, the basis for determining the frequency of disturbances that occur at the Rungkut Substation still cannot be found.

## III. RESULTS AND DISCUSSION

The predictions in this study were made based on observational data for a year, namely in 2020. Data collection was taken in the UP3 South Surabaya area which is addressed at Jl. Ngagel Tim. No.14, Pucang Sewu, Gubeng District, SBY City, East Java 60283 with location points as shown in Figure 3. Data collection is taken based on the dominance of disturbances that occur in the UP3 South Surabaya area in Figure 4.

TABLE 4
ELIGIBILITY INFORMATION FOR EACH CANDIDATE IMPAIRMENT IN A 7X5 MATRIX TABLE

| Information from Substations | Day Disruptions in 2020 | Various Disorders | | | | |
|---|---|---|---|---|---|---|
| | December | Material | Animal | Row | Undiscovered | Out of Control |
| Rungkut | 1 | 1 | 1 | 0 | 1 | 1 |
| Waru | 2 | 1 | 0 | 1 | 1 | 0 |
| Free Grand | 3 | 0 | 1 | 0 | 0 | 1 |
| Wonokromo | 4 | 0 | 1 | 0 | 0 | 1 |
| Wonorejo | 5 | 2 | 1 | 0 | 1 | 0 |
| Sukolilo | 6 | 0 | 0 | 1 | 0 | 0 |
| Ngagel | 7 | 0 | 0 | 0 | 0 | 0 |

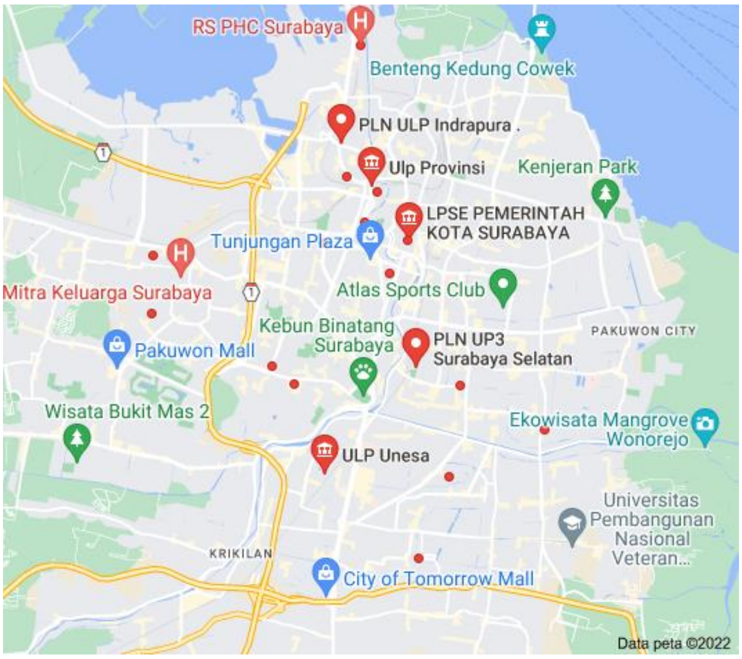


Figure 3. Location of UP3 South Surabaya

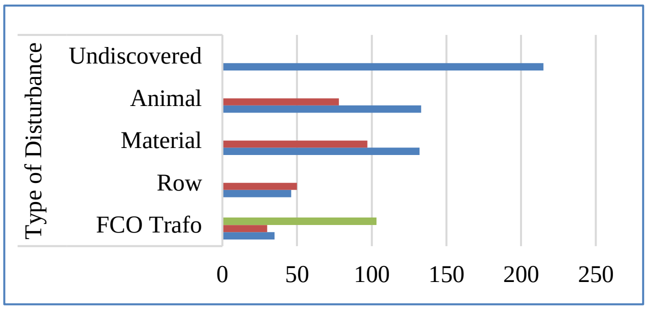


Figure 4. The dominance of UP3 disruption in South Surabaya in 2020.

The dominance of disturbances in UP3 Surabaya Selatan in 2020 can be seen in Figure 4 above. From the description of the dominance of disturbances obtained from the Substation, several types of disturbances can be seen which will then be hypothesized for the prediction of disturbances that may occur in the following year. This indicator uses data from seven substations for one year in the South Surabaya area. Observation data for one year, with sampling in December 2020, is presented in Table 2.

There are some differences in the types of interference between Figure 4 and Table 4. In Figure 4, ten types of interference dominance occur, while in Table 4, only five types of interference dominance are used. This difference is due to the fact that the dominance of interference such as that on arresters, FCO transformers and transformers falls under the category of material interference. On the other hand, the dominance of interference due to fallen trees and billboards falls under the category of uncontrolled interference. This is the reason why Table 4 only uses five types of disturbances.

After obtaining information on the eligibility of each candidate for interference, the next step is the determination $P(\psi)_{estimasi}$ obtained using (2). The results can be seen in Table 5. The final step is to

TABLE 5
ELIGIBILITY INFORMATION FOR EACH CANDIDATE IMPAIRMENT IN A 7X5 MATRIX TABLE

| No | Information from Substations | Various Disorders | | | | |
|---|---|---|---|---|---|---|
| | | Material | Animal | Row | Undiscovered | Out of Control |
| 1 | Rungkut | 0.2833 | 0.1764 | 0.0417 | 0.2736 | 0.2250 |
| 2 | Waru | 0.2972 | 0.1833 | 0.1278 | 0.2500 | 0.1417 |
| 3 | Free Grand | 0.3472 | 0.2778 | 0.1111 | 0.0417 | 0.1389 |
| 4 | Wonokromo | 0.0694 | 0.3472 | 0.1944 | 0.1389 | 0.1667 |
| 5 | Wonorejo | 0.2736 | 0.2667 | 0.1069 | 0.2667 | 0.0861 |
| 6 | Sukolilo | 0.0833 | 0.3472 | 0.2083 | 0.3194 | 0.0417 |
| 7 | Ngagel | 0.2083 | 0.0833 | 0.0417 | 0.2083 | 0.1250 |

TABLE 6
PREDICTED POWER INTERRUPTIONS IN 2021

| Repeater | DoC (%) | Types of disorders |
|---|---|---|
| Rungkut | 28.33 | Material |
| Waru | 29.72 | Material |
| Wonorejo | 27.36 | Animal |
| Sukolilo | 34.77 | Animal |
| Ngagel | 20.83 | Undiscovered |
| DarmoGrand | 34.72 | Material |
| Wonokromo | 34.72 | Animal |

TABLE 7
COMPARISON OF PREDICTIONS OF ELECTRICAL DISTURBANCES IN 2021 WITH OBSERVATIONS

| Prediction Results for 2021 | | | Results of PLN Data Observations in 2021 | |
|---|---|---|---|---|
| Master | DoC (%) | Types of disorders | Repeater | Types of disorders |
| Rungkut | 28,33 | Material | Rungkut | Material |
| Waru | 29.72 | Material | Waru | Row |
| Wonorejo | 27.36 | Animal | Wonorejo | Undiscovered |
| Sukolilo | 34.77 | Animal | Sukolilo | Undiscovered |
| Ngagel | 20.83 | Undiscovered | Ngagel | Material |
| Free Grand | 34.72 | Material | Free Grand | Material |
| Wonokromo | 34.72 | Animal | Wonokromo | Row |

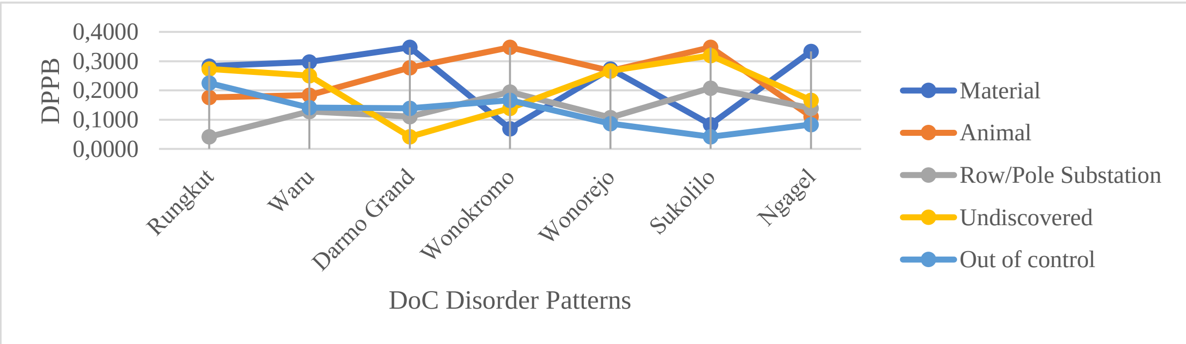


Figure 5. DoC Interference Pattern

determine the degree of confidence on which the prediction decision is based to establish the highest disturbance as the right choice. The DoC can be illustrated in Figure 5.

From Figure 5, it can be concluded that the prediction of electricity disruption for 2021 is listed in Table 6 below. This table is the basis for conducting interviews with PT PLN in the field to verify whether the predictions made are in accordance with the observations in the field. The interview results show that the type of material disturbance is the most common in the UP3 Surabaya Selatan area. This strengthens the belief that the KGS method can be recommended as an effective method for predicting disturbances.

Comparison of the calculation results of the KGS method for 2020 predictions with PLN observation data reveals differences in fault conditions, as shown in Table 7. Based on the results of data processing and analysis, it can be concluded that the prediction of electricity distribution disturbances in the UP3 South Surabaya area shows the highest confidence level of 34.77% occurring at Sukolilo Substation with the type of disturbance caused by animals. Meanwhile, the prediction of electricity distribution disturbances with the lowest confidence level of 20.83%, and the type of disturbance has not been found to occur at Ngagel Substation. For Rungkut Substation, the confidence degree value is 28.33%, Waru Substation has a confidence degree value of 29.72%, and Darmo Grand Substation has a confidence degree value of 34.72% with the type of material disturbance. Wonorejo Substation has a degree of confidence value of 27.36%, while Wonokromo has a degree of confidence value of 34.72% with the type of disturbance due to animals.

There are some discrepancies between the predicted results and field observations recorded in Table 7. Factors such as erratic weather conditions, periodic checks on materials that have reached their maximum service life, and maintenance in accordance with Standard Operating Procedures (SOPs) can cause this discrepancy. This can have an impact on the performance of materials that may not function optimally or have undergone maintenance by related parties in accordance with the SOP, which in turn can minimize disturbances that occur in the future.

## IV. CONCLUSION

In this study, a knowledge growing system (KGS) method was used to predict the disturbing type of power distribution at PLN unit in South Surabaya, East Java. Based on the calculation results, it can be concluded that KGS is able to quickly predict electricity interference in the observed area. Even though the disturbance data from the previous year is still used, KGS can successfully predict electricity distribution disturbances in the following year. From the findings of the KGS method for predicting electricity distribution disturbances, this research and information is expected to provide benefits to related parties. This allows for anticipation and handling of electricity distribution disruptions more quickly and precisely.

## REFERENCES

[1] M. S. Sungkar, O. Somantri, M. T. Qurohman, V. K. Bakti, and R. Rahim, “A proposed method using neural network for electricity price prediction base on genetic algorithm,” in *Journal of Physics: Conference Series*, IOP Publishing, 2019, p. 12063.
[2] Sekretariat PT PLN (Persero), *PLN Statistik 2020*. Sekretariat PT PLN (Persero), 2021.
[3] Sekretariat PT PLN (Persero), *PLN Statistik 2019*. Sekretariat PT PLN (Persero), 2020.
[4] S. Kamarani, I. Supriyadi, Y. D. Kuntjoro, and M. F. Rozi, “Implementation of the ASEAN Power Grid Interconnection West Kalimantan and Sarawak to Fulfill Electrical Energy Needs in Khatulistiwa,” *Int. J. Humanit. Educ. Soc. Sci.*, vol. 3, no. 3, 2023.
[5] A. D. W. Sumari, A. S. Ahmad, A. I. Wuryandari, J. Sembiring, and F. Sahlan, “An introduction to knowledge-growing system: a novel field in artificial intelligence,” *J. Ilm. Teknol. Inf.*, vol. 8, no. 2, pp. 11–20, 2010.
[6] E. Emidiana, “Prediksi Beban Listrik Jangka Pendek Wilayah Sumbagsel Berbasis Jaringan Syaraf Tiruan,” *J. Ampere*, vol. 1, no. 1, pp. 14–25, 2016.
[7] A. A. Zakri and H. Firdaus, “Penerapan anfis untuk peramalan gangguan pada transformator daya,” in *Prosiding Seminar Nasional Pakar*, 2019, pp. 1–3.
[8] K. O. Bachri, U. Khayam, B. A. Soedjarno, A. D. W. Sumari, and A. S. Ahmad, “Cognitive artificial-intelligence for doernenburg dissolved gas analysis interpretation,” *TELKOMNIKA (Telecommunication Comput. Electron. Control.*, vol. 17, no. 1, pp. 268–274, 2019.
[9] M. T. Andi Syofian, “Analisa Perhitungan Titik Gangguan pada Saluran Transmisi Menggunakan Metode Takagi Aplikasi PT. CHEVRON PACIFIC Indonesia,” *J. Tek. Elektro*, vol. 6, no. 2, pp. 204–208, 2017.
[10] E. R. Puspitaningtyas, S. Nisworo, and A. Trihasto, “Prediksi Sisa Usia Pakai Arester Zno Transformator Utama Berdasarkan Pengukuran Arus Bocor Resistif Korektif Menggunakan Metode Regresi Polinomial,” in *SENASTER" Seminar Nasional Riset Teknologi Terapan"*, 2020.
[11] A. D. W. Sumari, D. R. H. Putra, M. B. Musthofa, and N. Mari, “Pandemic dynamics prediction in Java using the Moving Average method and the Knowledge Growing System (KGS),” *J. Teknol. dan Sist. Komput*, vol. 9, no. 1, pp. 31–40, 2021.
[12] K. O. Bachri, B. Anggoro, A. D. W. Sumari, and A. S. Ahmad, “Cognitive Artificial Intelligence method for interpreting transformer condition based on maintenance data,” *Adv. Sci. Technol. Eng. Syst. J.*, vol. 2, no. 1, pp. 1137–1146, 2017.
[13] I. H. Kusumah, “Knowledge Growing System Implementation on Design of Unmanned Aerial Vehicle in Maritime Security Monitoring,” in *2019 5th International Conference on Computing Engineering and Design (ICCED)*, IEEE, 2019, pp. 1–6.
[14] A. D. W. Sumari, A. S. Ahmad, A. I. Wuryandari, and J. Sembiring, “Brain-inspired knowledge-growing system and its application in biomedical engineering: inferring genes behavior in genetic regulatory system,” *J. eHealth Technol. Appl.*, vol. 8, no. 2, pp. 141–151, 2010.
[15] A. D. W. Sumari, A. S. Ahmad, A. I. Wuryandari, and J. Sembiring, “Knowledge growing system: a new perspective on artificial intelligence,” in *Proceedings of the 5th International Conference Information & Communication Technology and System*, 2009, pp. 217–222.
[16] Q. Fitriyah and D. Istardi, “Prediksi Beban Listrik Pulau Bali Dengan Menggunakan Metode Backpropagasi,” in *Seminar Nasional Informatika (SEMNASIF)*, 2015.
[17] B. Handoko, “Peramalan Beban Listrik Jangka Pendek pada Sistem Kelistrikan Jawa Timur dan Bali Menggunakan Fuzzy Time Series,” *TugasAkhir, JurusanTeknikElektro, ITS, Surabaya*, 2010.