Simulação capaz de estimar o local ou a secção em falta dos sistemas elétricos de potência (SEP)

Simulation capable of estimating the local or fault section of electrical power systems (EPS)

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RESUMO
Este trabalho visa construir uma base necessária para um futuro desenvolvimento de uma simulação que possa auxiliar no diagnóstico de faltas em um sistema elétrico de potência. Foram pesquisadas maneiras de utilizar a lógica fuzzy em aplicações reais, para então a utilizar como suporte em uma análise de dados. Futuramente se busca que juntamente com outras técnicas que já estão sendo exploradas, como smartgrids, FFT (Fast Fourier Transform) e a transformada de wavelet se possa desenvolver uma técnica rápida e precisa na localização de problemas em sistemas elétricos de potência, como em transformadores, linhas de transmissão e linhas de distribuição.

Palavras-chave: Fuzzy; Simulação; Secção em falta.

ABSTRACT
This work seeks to build a necessary basis for a future development of a simulation that can aid in diagnosis of faults in an electric power system. Ways of using fuzzy logic in real applications were researched, and then used as a support in data analysis. In the future, it is sought that, together with other techniques that are already being explored, such as smartgrids, FFT (Fast Fourier Transform) and the wavelet transform, a fast and precise technique can be developed to locate problems in electrical power systems, such as power transformers, transmission lines and distribution lines.

Keywords: Fuzzy; Simulation; Fault section.

1 INTRODUCTION

Electricity consumption is linked to the level of development of a country, with industrial production and the purchasing power of the population. In view of this situation, the xpansion of the available power in the country's electrical system is often necessary, however, this increase usually implies a series of complications, such as high financial investment and the country's geographic dependence. Thus, an alternative is needed that is able to supply this growing need for electric energy. (PAULA, 2016).

In addition, it is necessary to have a good quality of the service offered, currently the quality of the energy supplied is closely linked to its uninterrupted supply. In the electrical power systems, one of the main factors for the interruption of services is the occurrence of faults, which demand a great effort from the restoration teams, as it requires a very thorough research in order to be able to find the reason for the fault (SOUZA, 2009).

In the event of a fault in electrical power systems, a large number of messages and alarms are transmitted to the control center after the disturbance has occurred. These disturbances are caused by innumerable types of faults in any part of the system, which makes the localization and resolution of the same an extremely complicated process, which must be resolved as soon as possible.

Currently, the application of intelligent systems for the diagnosis of faults has been extensively researched, such as artificial neural grids that are obtaining good efficiency in this study, since they are capable of providing results in difficult situations, such as in the presence of noise or failures in the system itself.

The protection systems are designed to isolate the defective component(s) in the system after the failure has occurred. The protection system seeks speed, selectivity and coordination.

2 METHODOLOGY

This work seeks to be able to carry out a fault occurrence simulation and a diagnosis made from a system based on *fuzzy* logic.

A system based on fuzzy logic has an advantage in relation to the processing cost, being more recommended for systems with limited processing capacity. This is in contrast to methods based on neural networks that require a rigorous training process in order to become efficient.

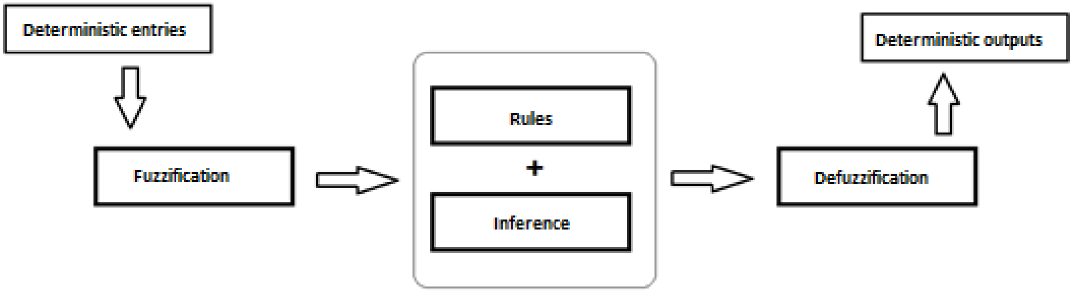
The differential of a system based on this logic is that it is able to represent inaccurate information through a degree of truth ranging from 0 (false) to 1 (true), with the intermediate values representing partially false or true conclusions (A. G. A. Cruz, 2017).

A fuzzy system is basically structured with the following processes (SOUZA, 2009) (FELIX, 2012):

- Deterministic inputs: Set of data obtained through observations or measurements of data, system input database.
- Fuzzification: Transformation of deterministic data into fuzzy data based on pertinence functions.
- Rules: Rules play a fundamental role in the fuzzy inference system, they are provided in the form of linguistic sentences by the responsible professional or even numerically from a large enough sample of data that reflect the behavior of the analyzed system.
- Inference: Moment when operations occur with the sets that correspond to the input and output information. These operations are functions that can be created manually or more often using automatic methods.
- Defuzzification: Process responsible for reading the data obtained by the fuzzy output set and transforming it into non-fuzzy data.
- Deterministic outputs: Non-fuzzy data obtained after the entire fuzzy system, normally necessary for practical applications.

The processes are organized according to Figure 1.

Figure 1 – Fuzzy logic processes



Source: Own authorship (2018).

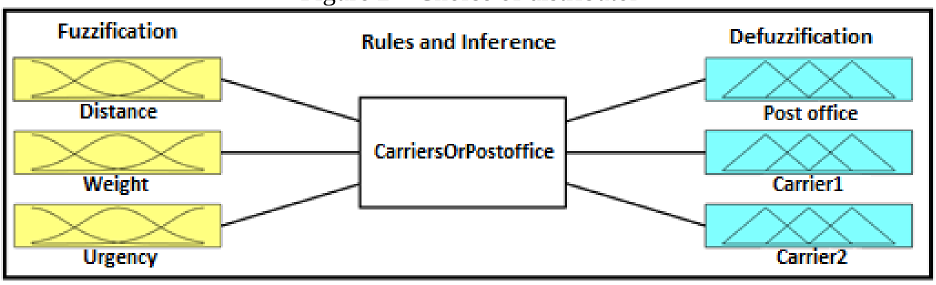
Then, a verification of the simulation carried out in the article (FELIX, 2012) from the *Fuzzy Logic Toolbox* do *software* MATLAB® to check the results.

The modeling of the input data (pertinence functions and fuzzification process) can be carried out from an equation created specifically for a given situation, or from some ready-made equations provided by the software, which will be sufficient for the application.

The simulation carried out seeks to find between three different distributors, namely, *Post oficce*, *Carrier1* and *Carrier2*. Each distributor with different delivery analysis characteristics, which take weight, urgency and delivery distance into account.

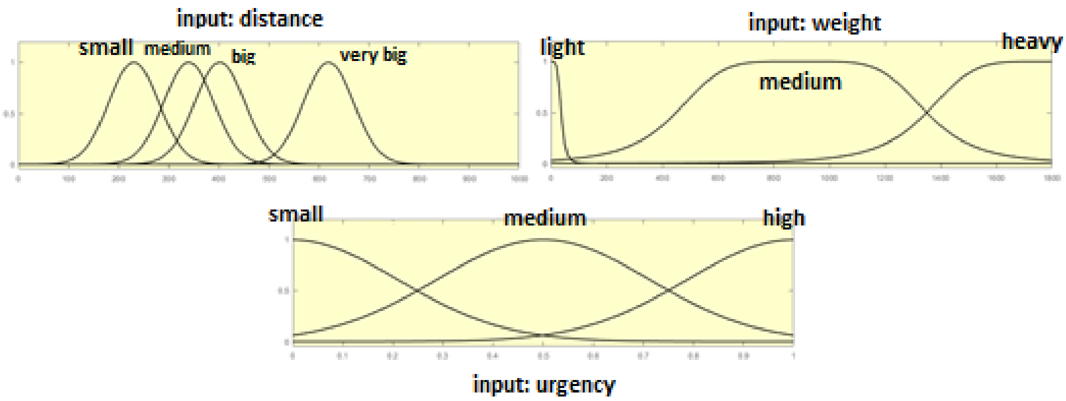
The system is then composed of three entrances, distance, weight and urgency, with the distance analyzed being from 0 to 1000km, weight from 0 to 1800kg and urgency a value from 0 to 1, the closer to 1 the greater is the urgency of delivery. The system follows the process represented in Figure 2, its inputs are all represented in Figure 3, the rules used in Figure 4 and its possible outputs in Figure 5, with the output of *Carrier1* being the same as that of *Carrier2*, differentiating from the set of rules.

Figure 2 – Choice of distributor



Source: Own authorship (2018).

Figure 3 – Fuzzy system inputs



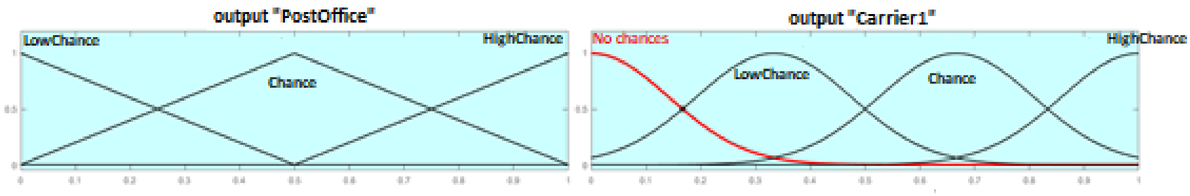
Source: Own authorship (2018).

Figure 4 – Fuzzy system rules

1. If (Weight is light) then (Postoffice is HighChance) (1)
2. If (Distance is small) and (Weight is not light) then (Carrier1 is HighChance) (1)
3. If (Distance is big) and (Weight is not light) then (Carrier1 is HighChance) (1)
4. If (Distance is medium) and (Weight is medium) and (Urgency is not high) then (Carrier1 is HighChance) (1)
5. If (Distance is verybig) and (Weight is medium) and (Urgency is not high) then (Carrier1 is HighChance) (1)
6. If (Distance is medium) and (Urgency is high) then (Carrier2 is HighChance) (1)
7. If (Distance is verybig) and (Urgency is high) then (Carrier2 is HighChance) (1)
8. If (Distance is medium) and (Weight is heavy) and (Urgency is not high) then (Carrier2 is HighChance) (1)
9. If (Distance is verybig) and (Weight is heavy) and (Urgency is not high) then (Postoffice is HighChance)(Carrier2 is HighChance) (1)

Source: Own authorship (2018).

Figure 5– Fuzzy system outputs



Source: Own authorship (2018).

3 RESULTS AND DISCUSSIONS

From a set of information referring to orders available at (FELIX, 2012) a test of the fuzzy system was carried out to choose the distributor.

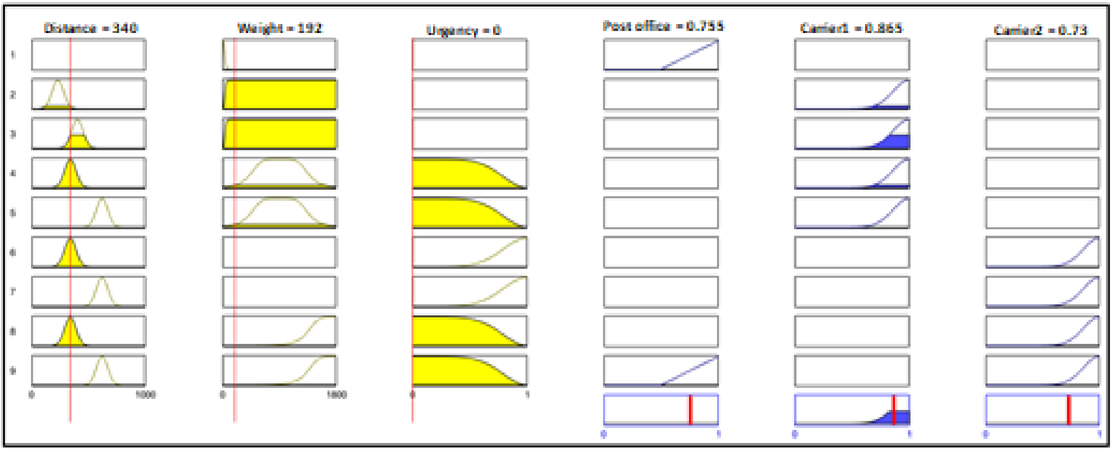
Table 1 was then obtained, which completely matches the results obtained in the verified article, Figure 6 shows a visualization of the distributor choice process for order 9, Carrier1 was chosen with a value of 0.865, such value represents the “how true” is the possibility of this distributor being really chosen. The system determines that a possibility must be determined because it has a greater degree of "truth" among the three available.

Table 1. Results of the simulation

Order	Weight (Kg)	Distance (Km)	Urgency	System Choice
1	4,8	233	0	Post office (0,84)
7	740	233	0	Carrier1 (0,89)
9	192	340	0	Carrier1 (0,86)
19	19,2	619	1	Carrier2 (0,89)

Source: Own authorship (2018).

Figure 6 – Results for order 9



Source: Own authorship (2018).

4 CONCLUSIONS

Although the current work does not present a study specifically related to the topic of initiation, it seeks to develop a process capable of performing a good fault diagnosis in an electrical power system, from a fuzzy system and tests in software not yet chosen that has the ability to represent an electrical system virtually (FILHO, 1999).

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