

## Application of Fuzzy Logic to Motorcycle Oil Change Cycle with 10W 30 Oil Viscosity

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### Abstract

Oil is a fluid that serves to lubricate the engine, so that friction between engine components is relatively small. Oil changes are based on mileage, oil volume, and oil viscosity levels which usually vary depending on the needs of the vehicle's engine. Most riders are often late and do not even know the routine time of oil changes so that the user's motorcycle engine feels damaged. The application of fuzzy logic has become an important approach in modeling the complex and ambiguous system of motorcycle oil change periods with 10W 30 oil viscosity. The purpose of this study is to determine the application of fuzzy logic in determining the optimal oil exchange interval. Oil is based on factors such as mileage, oil volume, and oil viscosity when viewed from motorcycle use. To represent these variables using fuzzy sets, a fuzzy logic control system was developed that takes into account oil wear and motorcycle operating conditions which was implemented using the mamdani method and calculated using matlab software. The results showed that oil change intervals tailored to operating conditions and the environment can improve engine performance, reduce maintenance costs and extend component life.

**Keywords:** fuzzy logic, mamdani method, motorcycle, oil change interval.

### INTRODUCTION

Transportation is the process of transporting a certain amount of goods or people to a certain location in a certain amount of time within a certain period of time. Today, means of transportation have become very important. Some people prefer to use private vehicles instead of public transportation. This is especially true of motorcycles (Wijayanti 2017). Means of transportation are increasingly used every day. The motor makes it easy to travel from one place to another in a fast time, such as to campus, school, office, and others (Aji Purnama Restu 2020). For the majority of Indonesians, motorcycles are still the main mainstay and the cheapest.

A motorcycle is a car with two wheels driven by an engine. Common means of transportation are used by many people to reach destinations, both inside and outside the city or in remote areas. In Indonesia, they are very popular because of their affordable price and ease of use, save fuel, and save money when driving (Kautsar *et al.* 2023). Currently, the production of motor vehicles has reached millions of units. According to the Central Bureau of Statistics (2017), motorcycle production in Indonesia in 2016 reached 5,931,285 units (Sujadi *et al.* 2018). Daily mobility by motorcycle is very effective. Therefore, that is the motivation for many motorcycle users in Indonesia.

With the advancement of technology and the increasing busyness of workers, often people forget or miss to change the production engine oil. This happens because the company does not have a reminder system or reminder to change the oil, which results in production machines breaking down or

having problems quickly (Samsinar *et al.* 2019). Most motorcycle users do not understand all the technical features and how motorcycles work; They only know how to operate it, so it is the workshop that is responsible for all repairs (Saro 2019). Oil is a viscous liquid chemical that is widely used in motorcycle engines (Asrori *et al.* 2023). In general, lubricating oil or commonly called oil is defined as a substance that is between two surfaces and moves proportionally to reduce friction between these surfaces. The basic principle of lubricant or oil is to prevent friction of solid objects (Azizah Lubis 2018).

In general, the role of lubricants is to prevent or reduce wear and friction. In addition to reducing frictional forces, lubricants also function to cool and regulate engine heat and control dirt or dirt to ensure good engine performance. Parts of the engine mechanism that are difficult to lubricate require considerable lubrication. Oil is usually obtained by processing oil through a multiphase distillation process based on its boiling point (Lumbantoruan dan Yulianti 2016). Sometimes users forget when to change their vehicle's oil, and sometimes they change their vehicle's oil when the engine starts to get wet, noisy or damaged (Ahmad Kurniawan Nasution 2023).

Used lubricating oil also has a certain service life, depending on the operation of the engine, lubricating oil is the most important tool so that the operation of the engine can run optimally (Syafwansyah Effendi dan Adawiyah 2014). Of course, the increasing number of oil choices today makes users a little confused, because all oil manufacturers say their oil is the best. However, on the other hand there are several things that can be used as comparisons, including knowing the nature of the vehicle you have, engine specifications, and the environment where most of the driving is done (temperature, humidity, dust, etc.) (Arnoldi 2009). In everyday life, oil life can be determined based on the duration of use and distance recorded by the speedometer. The distance that has been traveled by the vehicle becomes the main reference in assessing the feasibility of oil, in accordance with the motor vehicle manual (Irsyam 2019).

Viscosity is one of the most vulnerable elements of oil content because it refers to the viscosity of the oil or its resistance to flow. The viscosity of the oil directly depends on how well it acts as a lubricant and protects against impact between metal surfaces. Oil must flow at engine temperature or ambient temperature (Herlina *et al.* 2018). The viscosity measurement of lubricating oil liquid flow oil is calculated by standard measurements. The higher the flow resistance, the higher the viscosity and vice versa (Faizah 2020). High or low visibility indicates the viscosity resistance of the lubricating oil to temperature changes. The higher the lubricating oil index number, the smaller the change in viscosity when the temperature drops or rises. The value of this viscosity index is divided into 3 groups, namely: (Siskayanti dan Engkos Kosim 2017).

1. High Viscosity Index (HVI) above 80.
2. Medium Viscosity Index (MVI) 40–80.
3. Low Viscosity Index (LVI) below 40.

Classification of Lubricants Based on Their Viscosity Based on their viscosity or viscosity expressed in the figures of the Society of Automotive Engineers (SAE). The higher the SAE number means the thicker the lubricating oil. For example, single-stage and multi-stage oils. First-class oils, e.g. oils whose viscosity index is expressed by only one number, for example DEO SAE 30. While multigrade oil, which is oil whose viscosity index is expressed by more than one number. SAE DEO Examples 15W-40 (Pratama 2019). Mechanical contact between elements is inevitable in the engine. This mechanical exposure causes wear, some necessary and partly to be avoided (Darmanto 2011). The lubrication system greatly affects the efficiency and effectiveness of motorcycle engines, where each motor vehicle has its own power and amount of lubricating oil to lubricate each engine component (Ramanda *et al.* 2021).

In the field of informatics there are methods or algorithms that function to make decisions. The method used to determine the time and reminder uses the fuzzy method. Fuzzy is a way to map the input space to the output space (Saputri Dwi *et al.* 2019). In classical logic, the binary concept states that everything has only two possibilities: "Yes or No", "True or False", "Good or Bad", and so on. In this

context, the membership value can only take a value of 0 or 1, indicating clear membership or no membership at all. However, in fuzzy logic, membership values can vary in the range between 0 and 1. This means a state can have the possibility of "Yes and No", "Right and Wrong", or "Good and Bad" simultaneously. However, its membership tier is determined by the corresponding membership weight. Thus, fuzzy logic makes it possible to express the degree of certainty or uncertainty in a state more flexibly than classical logic. (Nasir dan Suprianto 2017). Fuzzy logic can be used in motorcycle maintenance to determine the ideal oil change interval. To change motorcycle oil regularly, you usually have to check the odometer to find out how much oil has been used and how much time has been spent. However, this cannot be used as a definitive measure to know whether the oil is still good or should be replaced because oil viscosity is the main factor that determines oil quality (Mardiyana *et al.* 2020). A fuzzy logic control system was created to take into account the degree of oil wear and the operational condition of the motorcycle. These variables are represented through fuzzy sets.

Based on these problems, this study was conducted to apply Fuzzy Logic in the motorcycle oil change cycle with an oil viscosity of 5W-30. 5W-30 or SAE 5W-30 oil has a viscosity of 5 at cold temperatures in winter (winter) and 30 at temperatures of 100 degrees Celsius (Surbakti 2019). The application is an innovative approach to improve the efficiency and reliability of vehicle maintenance. This study aims to optimize oil change intervals so as to extend motorcycle engine life and reduce maintenance costs. The Fuzzy Logic method allows the system to adjust oil change intervals adaptively based on data obtained from oil temperature and pressure sensors. With this approach, motorcycle owners can more accurately monitor oil condition and reduce the risk of engine damage from prolonged oil use.

In the context of this study, Mamdani's fuzzy method was chosen to calculate fuzzy logic. This method became the main choice because of its popularity and success in use in control systems, especially in the design of steam engine and boiler control systems by Ebrahim Mamdani in 1975. Mamdani's approach is based on fuzzy set theory and uses IF-THEN rules gathered from experienced operators or experts. The Mamdani method is often also referred to as the MaxMin method. (Maryam *et al.* 2021).

## **METHODS**

This study uses a qualitative approach to test the application of fuzzy logic in determining the oil change cycle in motorcycles with an oil viscosity of 10W-30. The design of this research includes the development of fuzzy logic control systems, collection of motorcycle operational data, and analysis of simulation results. This research method is applied in a span of about 2 months, starting from February 1 to March 1, 2024.

### **Data Collection Techniques**

Data collection techniques applied in qualitative research in this study are 1) Interview, is a data collection technique that involves direct interaction between researchers and researchers. is a data collection technique that involves direct communication between researchers and researchers. The purpose of qualitative interviews is to gain an in-depth understanding of individual experiences, views and perspectives on the phenomenon under study (Creswell 2014). 2) Observation, is a data collection method in which qualitative observations are made directly to the participants and contexts involved in the research phenomenon. This research can make observations both in real-life environments and in environments created specifically for research purposes (Ardiansyah *et al.* 2023).

#### **1. Interview**

In this study, interviews were conducted with online respondents who have relevant knowledge and experience in motorcycle maintenance, especially related to oil change cycles.

## 2. Observation

In this study, conduct observation or research to collect relevant motorcycle operational data, such as kilometers traveled, oil capacity and service life on the motorcycle. The following research design scheme is in the picture below:

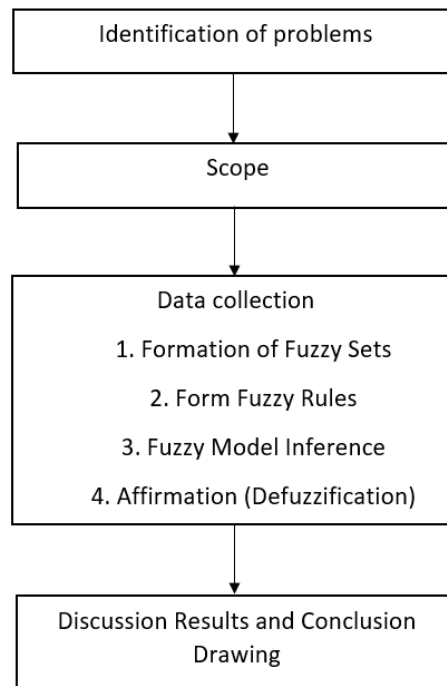


Figure 1. Research Design

In this study, there are several stages which include problem identification, scope, data collection, as well as the results of discussion and conclusions.

### 1. Identify the Problem

Identifying problems regarding motorcycle oil change cycles with 10w 30 oil viscosity includes several aspects that need to be considered thoroughly. First, a lack of clear understanding of the optimal interval for changing the oil can be a major problem. Without sufficient knowledge, motorcycle owners may neglect or perform oil changes too often, which can have an impact on engine performance and durability. In addition, there is also a need to consider the diverse operational environment of motorcycles, such as kilometers traveled, oil quality, and oil capacity on motorcycles.

### 2. Scope

The scope related to the Oil Change Cycle on motorcycles using 10W 30 oil includes several aspects that need to be considered thoroughly. First, this study will include an analysis of the ideal frequency in performing oil changes on motorcycles using this type of 10W 30 oil. This includes understanding factors such as motorcycle usage conditions, operational environment, and engine characteristics that influence the need for periodic oil changes. Furthermore, this scope will pay attention to the effect of 10W 30 oil viscosity on motorcycle engine performance within a certain period of time.

### 3. Data Collection

In this data collection, it will be carried out in several stages that adopt the fuzzy method. The stages of the fuzzy method will be used as a framework to structure the data collection process systematically and continuously. As well as identifying the Input and Output Variables of the data collection method. Research variables are any symptoms that appear and are used as research objects. When checked, these variables have different meanings and values (Sitohang dan Denson Napitupulu 2017). Input and output variables in fuzzy logic control systems are identified based on factors affecting oil wear and oil change intervals. Primary data was collected by distributing questionnaires through electronic media such as Google Forms. This study used a closed questionnaire, in which respondents' answers had been pre-established by the researcher. This aims to ensure that the answers given are in accordance with the needs of

the researcher. From the results of data collection with questionnaires, the basis of fuzzy rules (Fuzzy Rule Based) was formed.

#### 4. Results of Discussion and Conclusions

This stage is an important part of the research process, the analysis of the data that has been collected is detailed and evaluated thoroughly. This explanation should be based on clear logic and evidence, and include an explanation of the implications of the findings on relevant theory, practice, or policy.

### Data Analysis Techniques

Data analysis is an attempt to systematically find and organize observations, interviews, and other results to increase researchers' understanding of the cases they study and convey their findings to others (Nurdewi 2022). After the data is collected and calculated through collection and observation methods, Mamdani's fuzzy logic method will be used to analyze the data. Fuzzy logic is used because the mathematical concepts underlying fuzzy reasoning are very simple and easy to understand, very flexible, and capable of handling erroneous data (Ismiatul Kharomah dan Rosyida 2020). One fuzzy inference system is the Mamdani method, which requires four stages to produce output. Matlab, or Matrix Laboratory, is a program that can be used to implement fuzzy logic systems, and has a variety of tools that support the Mamdani method (Julpia dan Mashuri 2021). Based on the data collection techniques above, data analysis will be carried out using the *Fuzzy Inference System* (FIS) stages of the research we made, namely:

#### 1. Defining Input and Output Variables

Specifies the input variable that will be used as input in the system and the output variable that will produce output from the system. Input variables usually include factors that affect the system, while output variables are the results to be achieved.

#### 2. Building a Fuzzy Set from each Variable

Once the input and output variables are defined, the next step is to build a fuzzy set or membership set for each of those variables. This involves dividing the range of values of each variable into corresponding fuzzy sets, such as "low", "medium", and "high".

#### 3. Defining Fuzzy Operators

Fuzzy operators such as AND, OR, and NOT are defined to connect between fuzzy sets of input and output variables. This operator allows any combination of membership values from different fuzzy sets.

#### 4. Defining Implication Functions

The implication function determines how the input variable affects the output variable. This can be done using IF-THEN rules that connect the fuzzy set of the input variable with the fuzzy set of the output variable.

#### 5. Composing All Outputs

This step involves combining all output results produced by predefined fuzzy rules. This can be done using operations such as aggregation.

#### 6. Defuzzification

7. The defuzzification is the process of changing the fuzzy magnitude expressed in the output fuzzy set by using the membership function to get back a well-defined form. This is necessary because real-world applications require clear values. How is it accomplished? Choosing the right defuzzification method also affects the ability of fuzzy logic control systems to provide operational functionality. In fuzzy logic control systems, defuzzification is the last step that aims to convert all inference engine results, represented in fuzzy sets, into real numbers. The fuzzy output of the rule evaluation is taken and fed into the membership function's output. The defuzzification method uses this value and produces a crispy output. (Suhaila *et al.* 2024).

## RESULTS AND DISCUSSION

### Defining Input and Output Variables

Research on the application of fuzzy logic to oil change cycles on motorcycles with an oil viscosity of 10W 30 involves 2 input variables and 1 output variable.

Table 1. Defining Variables

Function	Variable Name	Unit
Input	Mileage	km
	Oil Capacity	ml
Output	Oil Change Time	Day

In applying fuzzy logic to the oil change cycle on motorcycles with an oil viscosity of 10W 30, there are 2 input variables and 1 output variable determined. The first input variable is the operational condition of the motorcycle, which includes factors such as mileage on the motorcycle. The second input variable is about the engine on the motor such as oil capacity. Meanwhile, the output variable is the optimal time interval for oil changes, which indicates when the oil should be changed based on the conditions that have been inputted.

### Build a Fuzzy Set from each Variable

In the formation of fuzzy sets in the application of fuzzy logic to oil change cycles on motorcycles with an oil viscosity of 10W 30, the first step is to identify the input and output variables and the range of possible values for each of those variables.

Table 2. Formation of Fuzzy Sets

Function	Variable Name	Fuzzy Sets	Domain
Input	Mileage (km)	LOW	[0 2000]
		MEDIUM	[1000 3000]
		HIGH	[2000 5000]
Input	Oil Capacity (ml)	SMALL	[600 1000]
		MEDIUM	[1000 3000]
		BIG	[3000 5000]
Input	Oil Change Time (Day)	FAST	[20 50]
		MEDIUM	[50 80]
		LONG	[80 110]

Here is an explanation of the membership set of each input variable:

- The graph of the variable input mileage (km), can be seen in figure 2.

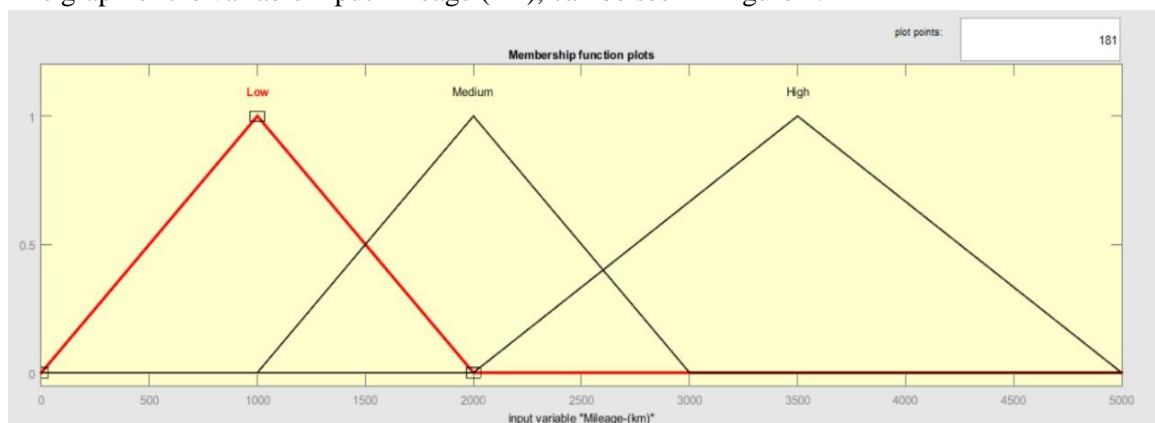


Figure 2. Input Mileage Graph

The first input is the mileage, which has a range between 0 to 5000 kilometers. This fuzzy set for inputs falls into three categories: low (0-2000 km), medium (1000-3000 km), and high (2000-5000 km), with each having a corresponding membership function.

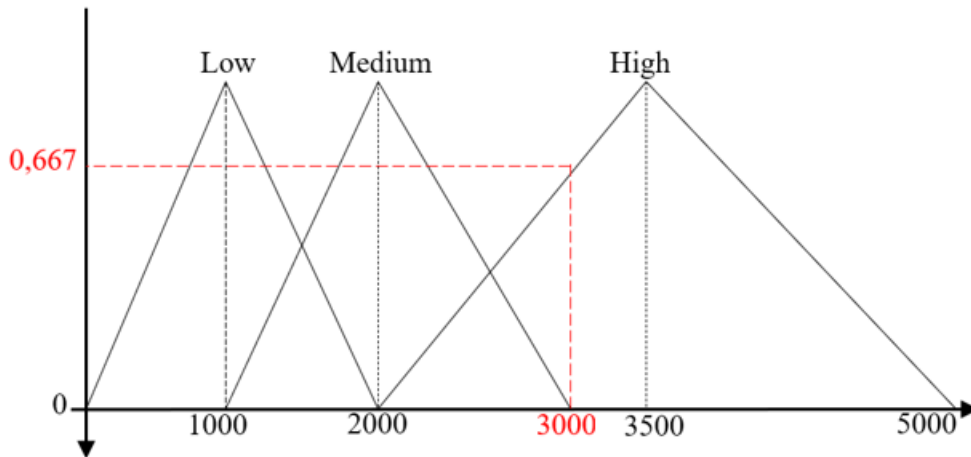


Figure 3. Membership Function Mileage 3000 km

Set Membership:

$$F(x, a, b, c) = \begin{cases} x < 2000 & 0 \\ 2000 \leq x \leq 3000 & \frac{x - 2000}{3000 - 2000} \\ 3000 \leq x \leq 5000 & \frac{5000 - x}{5000 - 3000} \\ x > 5000 & 0 \end{cases}$$

Membership Degrees:

$$\mu_{m\_Big}(3000) = \frac{3000 - 2000}{3500 - 2000} = \frac{1000}{1500} = 0,667$$

2. The graph of the variable input capacity oil (ml), can be seen in figure 4.

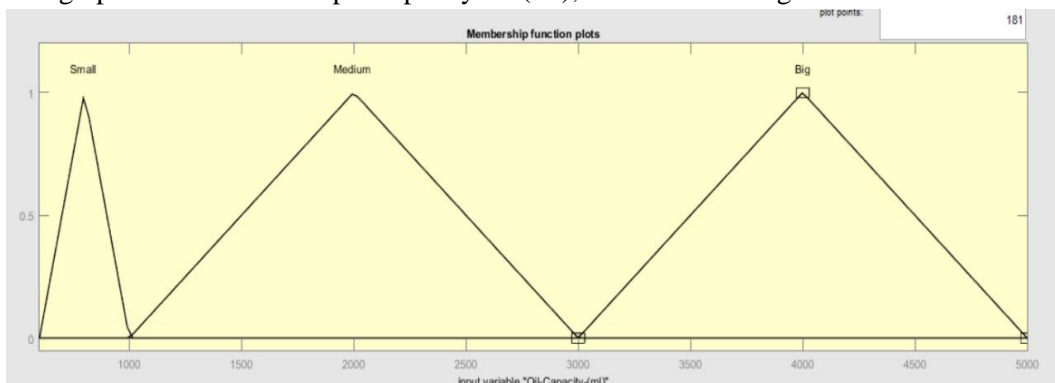


Figure 4. Input Oil Capacity Graph

The second input is the oil capacity in the motorcycle, which also has a range between 0 to 5000 milliliters. These fuzzy sets for inputs also fall into three categories: small (600-1000 ml), medium (1000-3000 ml), and big (3000-5000 ml), with corresponding membership functions.

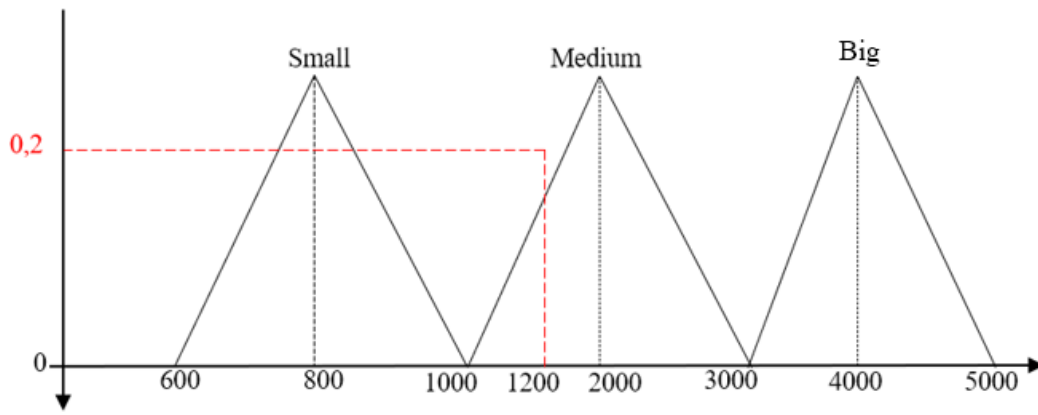


Figure 5. Membership Function Capacity Oil 12000 ml

Set Membership:

$$F(x, a, b, c) = \begin{cases} x < 1000 & 0 \\ 1000 \leq x \leq 2000 & \frac{x - 1000}{2000 - 1000} \\ 2000 \leq x \leq 3000 & \frac{3000 - x}{3000 - 2000} \\ x > 3000 & 0 \end{cases}$$

Membership Degrees:

$$\mu_{oc\_Medium}(1200) = \frac{1200 - 1000}{2000 - 1000} = \frac{200}{1000} = 0,2$$

### The Establishment of Fuzzy Rules

Once you have the variable to use, the rules that determine the output of the fuzification are formed.

Table 3. The Establishment of Fuzzy Rules

No	Mileage (km)	Oil Capacity (ml)	Oil Change Time (day)
1	LOW	SMALL	MEDIUM
2	LOW	MEDIUM	LONG
3	LOW	BIG	LONG
4	MEDIUM	SMALL	FAST
5	MEDIUM	MEDIUM	MEDIUM
6	MEDIUM	BIG	LONG
7	HIGH	SMALL	FAST
8	HIGH	MEDIUM	MEDIUM
9	HIGH	BIG	LONG

### Defining Fuzzy Operators

Fuzzy operators commonly used in this context include the linguistic operators AND and OR. The AND operator is used to connect two input conditions that must be met simultaneously to produce an output, while the OR operator connects two input conditions where one of them needs to be met to produce an output.

[R8] If the mileage is HIGH and the oil capacity is MEDIUM then the oil change time is MEDIUM.

$$\mu_8 = \text{Min}(\mu_{m\_High}[3000] \cap \mu_{oc\_Medium}[1200])$$

$$\mu_8 = \text{Min}(0,6 ; 0,2)$$

$$\mu_8 = 0,2$$

## Defining Implication Functions

In determining fuzzy operators, a fuzzy-based rule from rule 8 is used, where the output is medium. Thus, in the determination of the implication function, the calculation of output is carried out at the point of membership corresponding to the medium category. In figures 6 and 7 there are graphs on the output of the time of change of days and the results of the function of the Regional Results of the Composition of the Regulation.

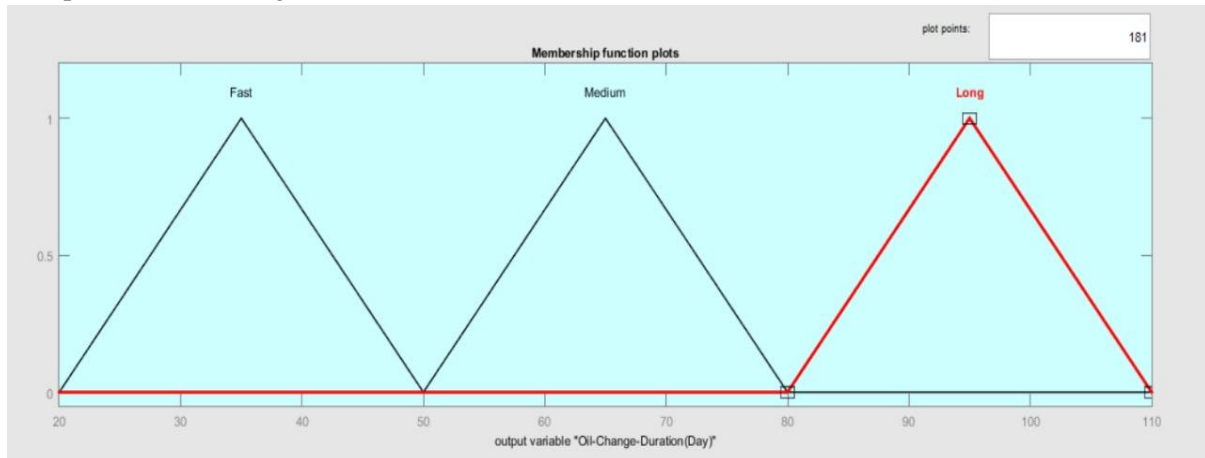


Figure 6. Oil Change Time Output Graph

## Composing All Outputs

After that, performing calculations determines the function implications of both sides of the medium membership in the output.

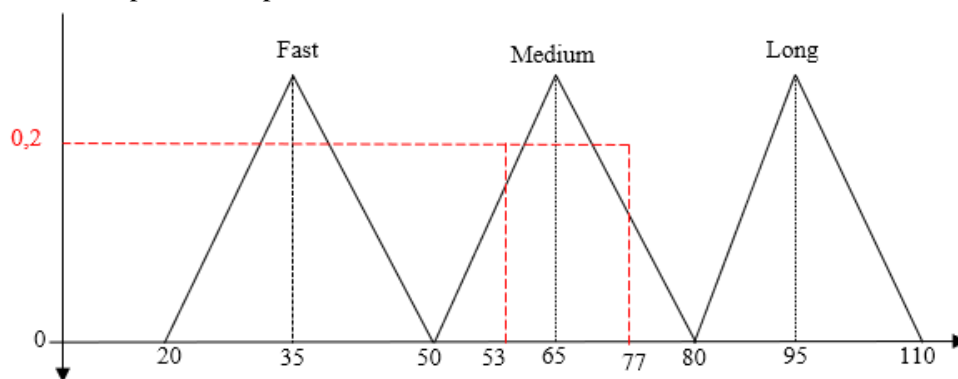


Figure 7. The Result Area of The Rule Composition

a. Left side of medium duration

$$\alpha_1 = \frac{x_1 - 50}{65 - 50}$$

$$0,2 = \frac{x_1 - 50}{65 - 50}$$

$$0,2 = \frac{x_1 - 50}{15}$$

$$3 = x_1 - 50$$

$$3 + 50 = x_1$$

$$53 = x_1$$

b. Right side of medium duration

$$\alpha_2 = \frac{80 - x_2}{80 - 65}$$

$$0,2 = \frac{80 - x_2}{80 - 65}$$

$$0,2 = \frac{80 - x_2}{15}$$

$$3 = 80 - x_2$$

$$x_2 = 80 - 3$$

$$x_2 = 77$$

From the calculation above, fuzzy area results are obtained with the following membership results.

$$F(x, a, b, c) = \left\{ \begin{array}{ll} x < 50 & 0 \\ 50 \leq x \leq 53 & \frac{x - 50}{53 - 50} \\ 53 \leq x \leq 77 & 0,2 \\ 77 \leq x \leq 80 & \frac{80 - x}{80 - 77} \\ x > 80 & 0 \end{array} \right\}$$

## Defuzzification

Using centroid method for defuzzification. Centroid method is a method where all fuzzy regions of the rule composition results are combined with the aim of forming optimal results and taking the center point of fuzzy areas. Below is the calculation of area size:

$$\begin{aligned} LD 1 &= \frac{(53-50) \times 0,2}{2} & LD 2 &= \frac{(77-53) \times 0,2}{2} & LD 3 &= \frac{(80-77) \times 0,2}{2} \\ LD 1 &= \frac{0,6}{2} = 0,3 & LD 2 &= \frac{4,8}{2} = 2,4 & LD 3 &= \frac{0,6}{2} = 0,3 \end{aligned}$$

Thus, the area is calculated in advance using the triangular area calculation method. Then, the results of these calculations are reused in the calculation of moments.

$$\begin{aligned} M1 &= \frac{\int \frac{(50 \times 0.6667 \times (x - 2000))}{(3000 - 2000)} dx}{\int \frac{(0.6667 \times (x - 2000))}{(3000 - 2000)} dx} = 35 \\ M2 &= \frac{\int \frac{(80 \times 0.2 \times (x - 5000))}{(8000 - 5000)} dx}{\int \frac{(0.2 \times (x - 5000))}{(8000 - 5000)} dx} = 28,75 \end{aligned}$$

Thus, the midpoint of the fuzzy area is obtained as follows:

$$Z = 35 + 28.75 = 63,75$$

The defuzzification results with a HIGH mileage (3000), and MEDIUM oil capacity (1200) show 63.75 in the MEDIUM Oil Change Period, with oil changes every 2 months for 20 days (50 days, 65 days, 80 days) means that the results obtained are in accordance with the rules and can be adjusted.

## Implementation System

The implementation of the fuzzy calculation system with the Mamdani method using the MATLAB R2015a application in the context of applying fuzzy logic to the oil change cycle on motorcycles with an oil viscosity of 10W 30 involves several steps:

1. Fuzzy inference system diagram design, can be seen in figure 8.

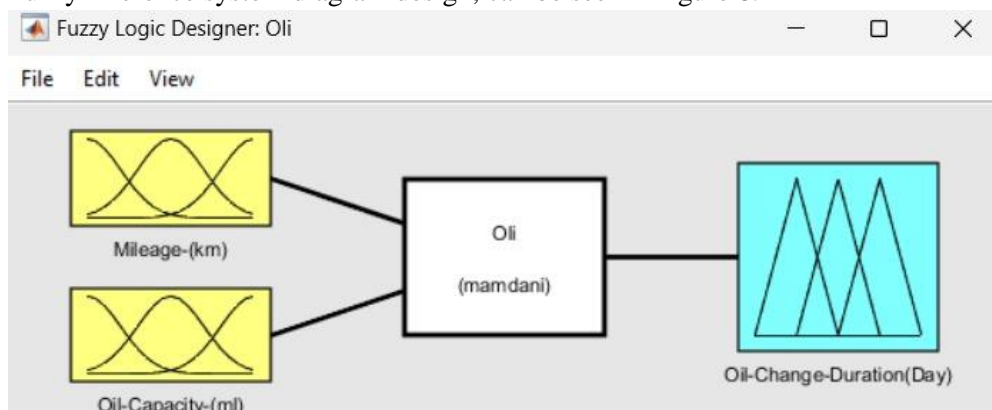


Figure 8. Fuzzy Inference System Diagram Design

2. Implementation of the formation of basic rules

After obtaining the variables to be used, rules are formed that determine the output of fuzzification.

1. If (Mileage-(km) is Low) and (Oil-Capacity-(ml) is Small) then (Oil-Change-Duration(Day) is Medium) (1)
2. If (Mileage-(km) is Low) and (Oil-Capacity-(ml) is Medium) then (Oil-Change-Duration(Day) is Long) (1)
3. If (Mileage-(km) is Low) and (Oil-Capacity-(ml) is Big) then (Oil-Change-Duration(Day) is Long) (1)
4. If (Mileage-(km) is Medium) and (Oil-Capacity-(ml) is Small) then (Oil-Change-Duration(Day) is Fast) (1)
5. If (Mileage-(km) is Medium) and (Oil-Capacity-(ml) is Medium) then (Oil-Change-Duration(Day) is Medium) (1)
6. If (Mileage-(km) is Medium) and (Oil-Capacity-(ml) is Big) then (Oil-Change-Duration(Day) is Long) (1)
7. If (Mileage-(km) is High) and (Oil-Capacity-(ml) is Small) then (Oil-Change-Duration(Day) is Fast) (1)
8. If (Mileage-(km) is High) and (Oil-Capacity-(ml) is Medium) then (Oil-Change-Duration(Day) is Medium) (1)
9. If (Mileage-(km) is High) and (Oil-Capacity-(ml) is Big) then (Oil-Change-Duration(Day) is Long) (1)

Figure 9. Fuzy Rule Based

- The last stage is the rule viewer which is used to perform and test the calculation of defuzzification results based on the data input. As figure 10 shows:

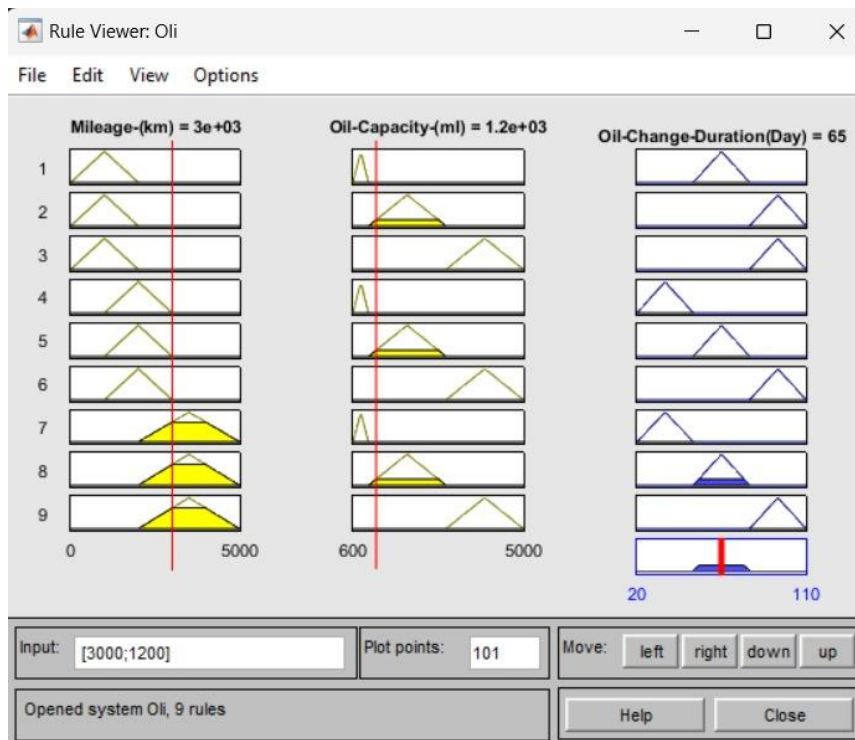


Figure 10. Rule Viewer Mamdani

The defuzzification results in matlab software are not much different from the manual calculations above, with the results of defuzzification of input mileage HIGH (3000), and oil capacity MEDIUM (1200) showing 65 in the MEDIUM Oil Change Period, with oil changes every 2 months for 20 days (50 days, 65 days, 80 days) means that the results obtained are in accordance with the rules and can be adjusted.

## CONCLUSION

That the application of fuzzy logic to the oil change cycle on motorcycles with an oil viscosity of 10W 30, using defuzzification results in MATLAB software, shows good consistency with manual calculations carried out previously. In the specific example presented, when the mileage input is categorized as HIGH (3000) and the oil capacity as MEDIUM (1200), the oil change period in the MEDIUM category is approximately 65 days. This is in accordance with the established rules, namely oil changes are carried out every 2 months, or about 20 days (50 days, 65 days, 80 days). Therefore, it can be concluded that the results of defuzzification reflect proper adjustment to the established rules, and can reliably meet practical needs in the management of oil change cycles in motorcycles with an oil viscosity of 10W 30. The application of fuzzy logic to oil change cycles on motorcycles with an oil viscosity of 10W 30 has been carefully investigated. The results showed that the use of fuzzy logic provides a more adaptive and precise approach in determining the right time to change oil, using the Mamdani method to calculate oil change output based on mileage and oil capacity. This research makes an important contribution in the field of vehicle maintenance and can be the basis for further development in artificial intelligence-based vehicle monitoring and maintenance systems.

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