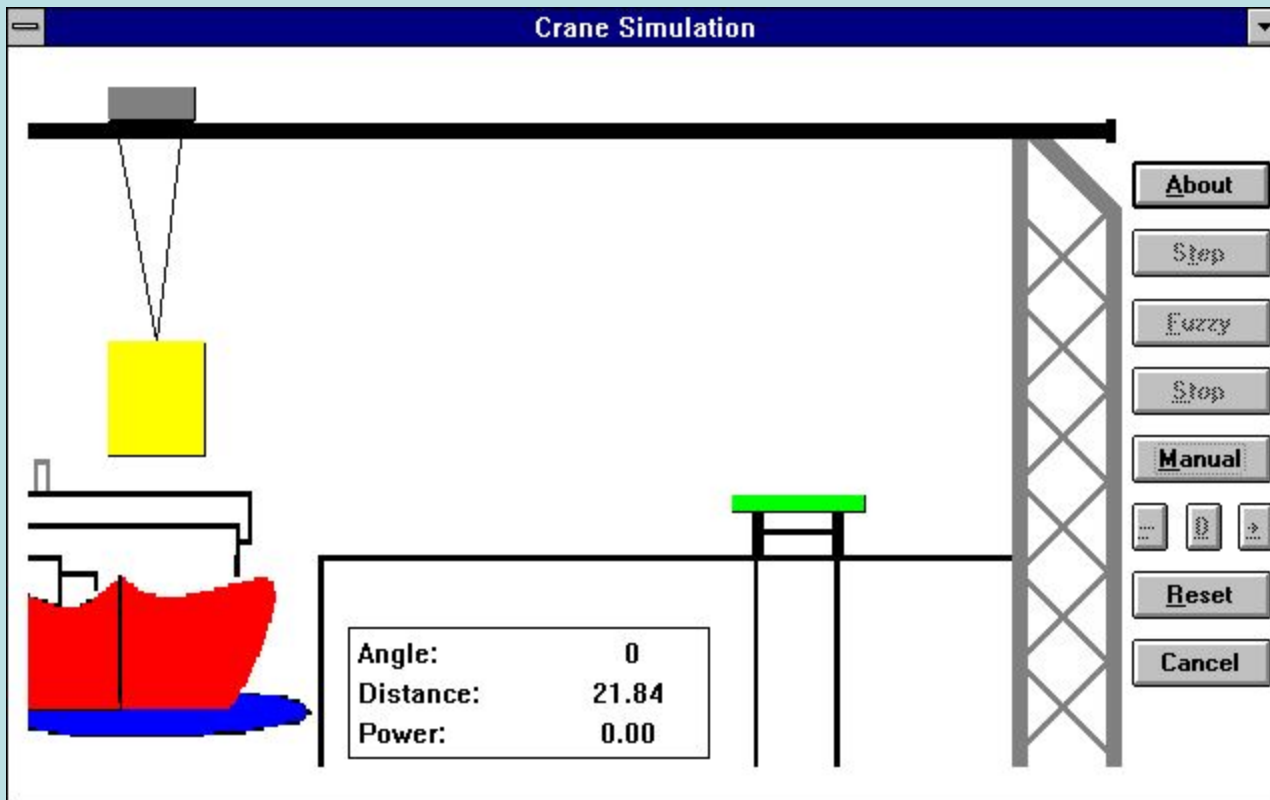


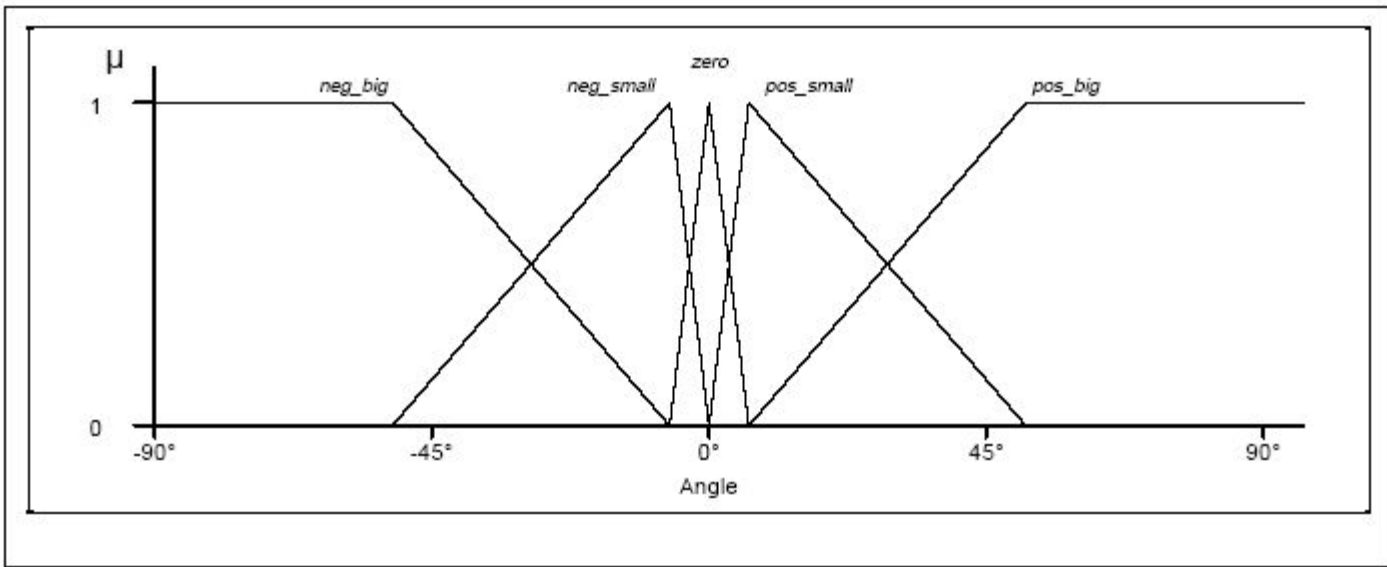
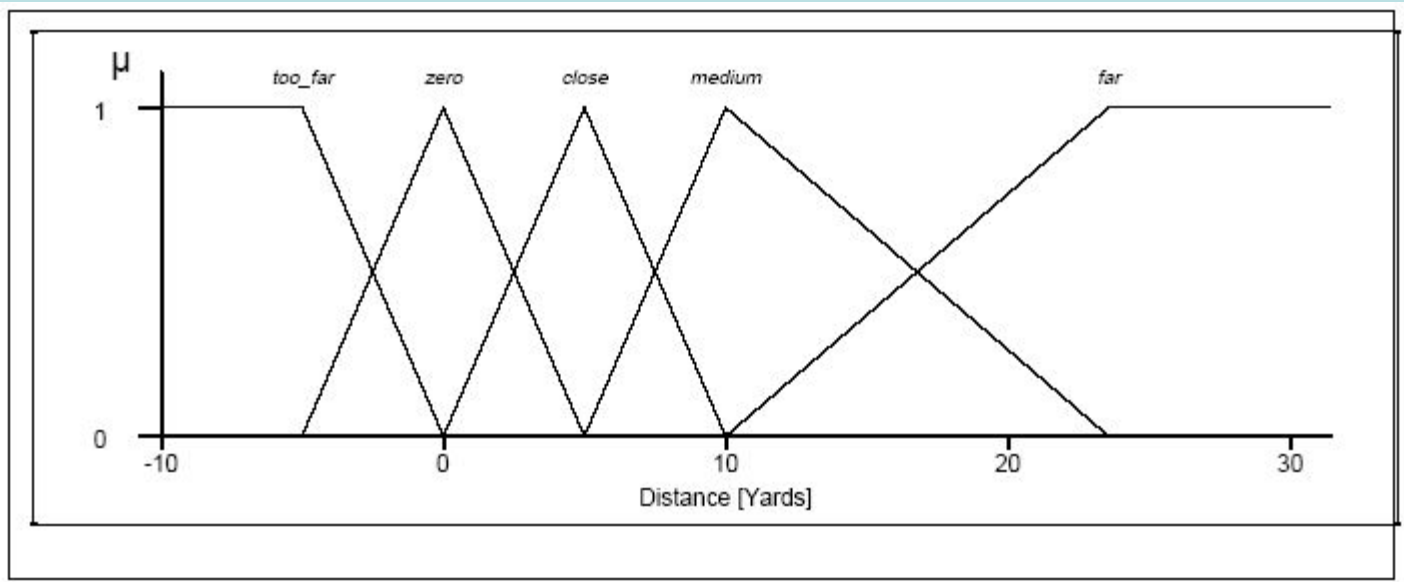
# НЕЧЕТКОЕ УПРАВЛЕНИЕ КОНТЕЙНЕРНЫМ КРАНОМ

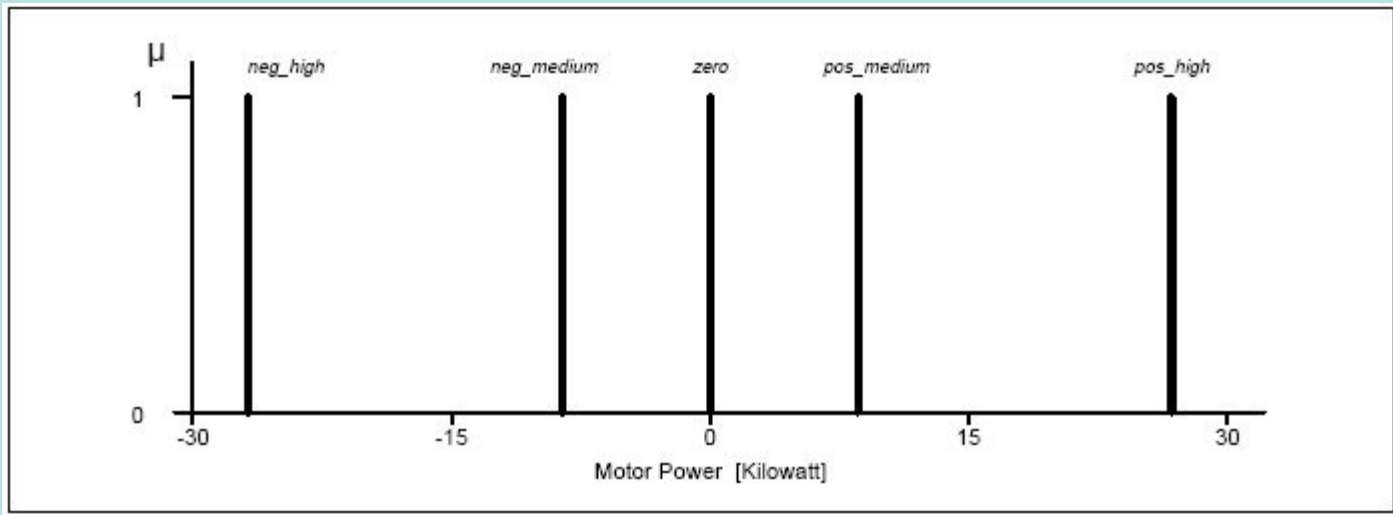


# *Интуитивные правила действий оператора крана*

Анализ действий оператора показывает, что он использует ряд эмпирических правил при управлении краном:

1. Начинать движение со средней мощностью.
2. Если кран тронулся, регулировать мощность так, чтобы контейнер немного отставал от тележки крана.
3. При приближении к цели уменьшить скорость, так чтобы контейнер немного опережал тележку крана.
4. Если контейнер очень близко к цели, включить мотор.
5. Если контейнер над целью и колебаний нет, выключить мотор.





# База правил контроллера

RULE 1: IF distance IS far	AND angle IS zero	THEN power IS pos_medium
RULE 2: IF distance IS far	AND angle IS neg_small	THEN power IS pos_big
RULE 3: IF distance IS far	AND angle IS neg_big	THEN power IS pos_medium
RULE 4: IF distance IS medium	AND angle IS neg_small	THEN power IS neg_medium
RULE 5: IF distance IS close	AND angle IS pos_small	THEN power IS pos_medium
RULE 6: IF distance IS zero	AND angle IS zero	THEN power IS zero


# Этапы вывода

Execution of the rule base broken down into the following steps:

- Aggregation  
Determining the degree of accomplishment of the condition from the degree of membership of the subconditions

$$P_{k1} \quad \text{AND} \quad P_{k2} \quad \text{OR} \quad (\text{NOT } P_{k3}) \quad = \quad P_k$$

for all n conditions



- Activation  
Activation of the IF-THEN conclusion

$$\text{If condition } P_k \quad \text{THEN conclusion } C_k$$

for all n rules



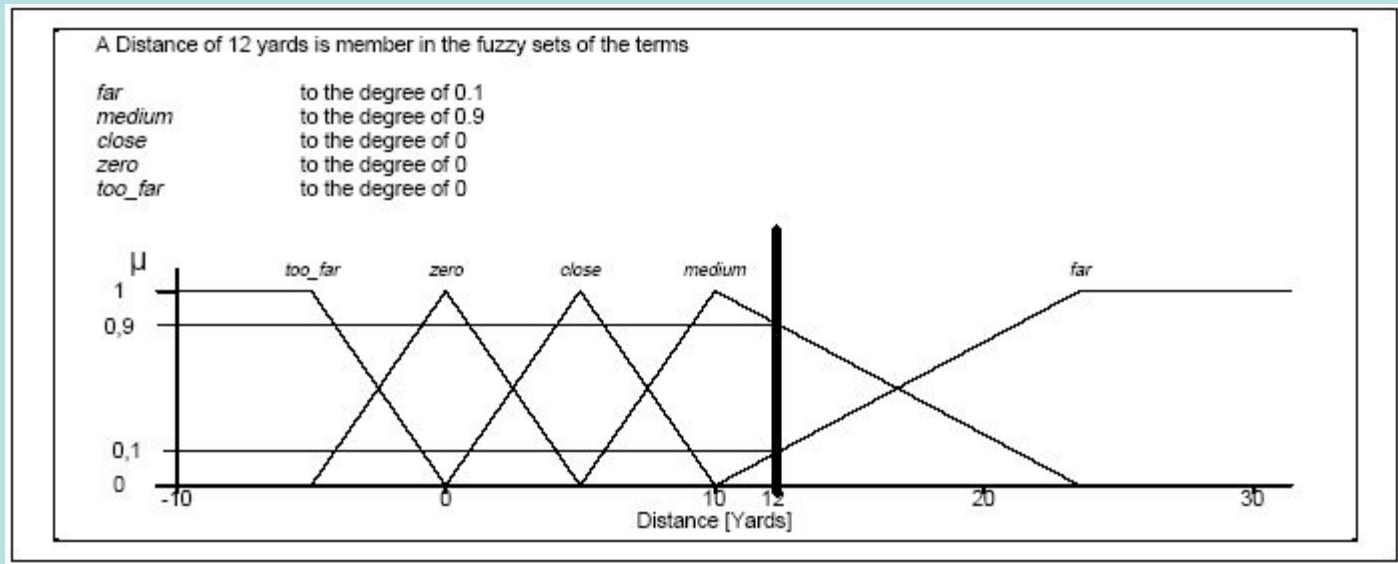
- Consideration of the weighting factor of each rule

- Accumulation  
Combination of the weighted results of the rules into an overall result

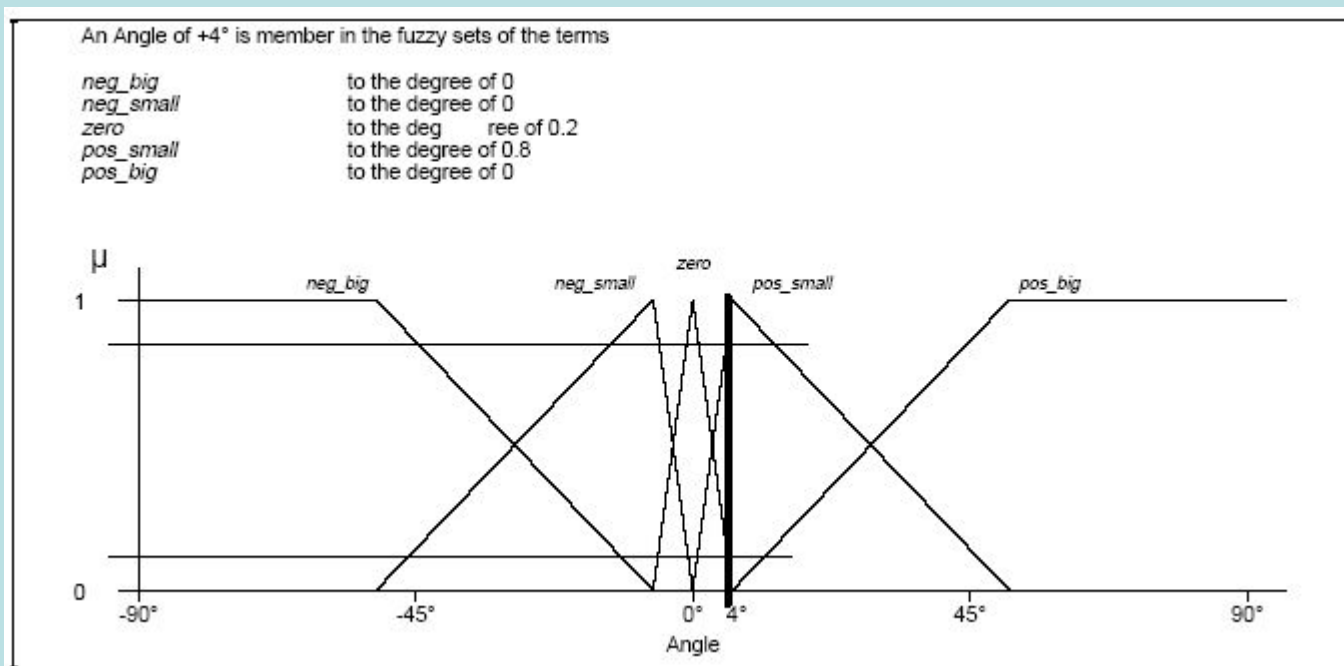
<i>Inference step</i>	<i>Operators</i>
<i>Aggregation</i>	
<i>AND</i>	<i>Minimum</i>
<i>Activation</i>	
<i>conversion of the IF-THEN-conclusion</i>	
	<i>Minimum</i>
<i>Accumulation</i>	<i>Maximum</i>



# Фазификация (1)

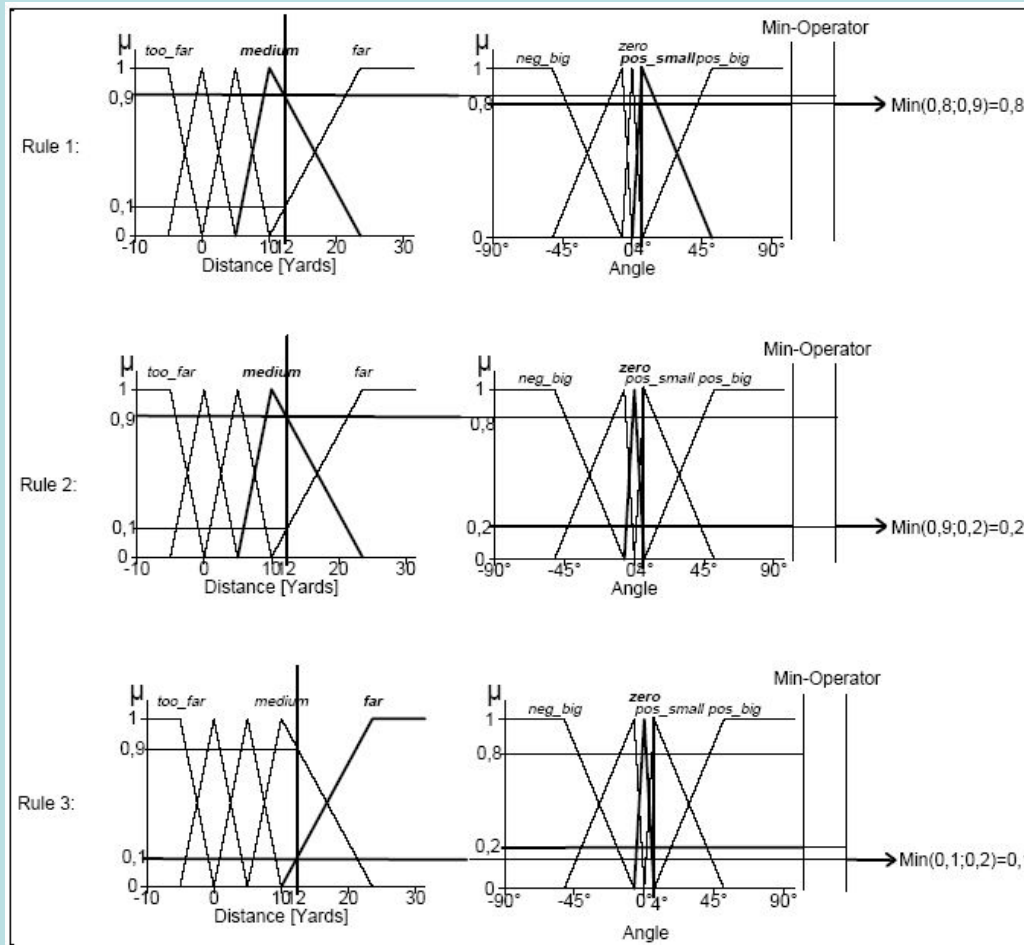


# Фазификация (2)



Rule 1: IF distance IS medium AND angle IS pos_small	THEN power IS pos_medium
Rule 2: IF distance IS medium AND angle IS zero	THEN power IS zero
Rule 3: IF distance IS far AND angle IS zero	THEN power IS pos_medium

# Фазификация (3)



# Активирование



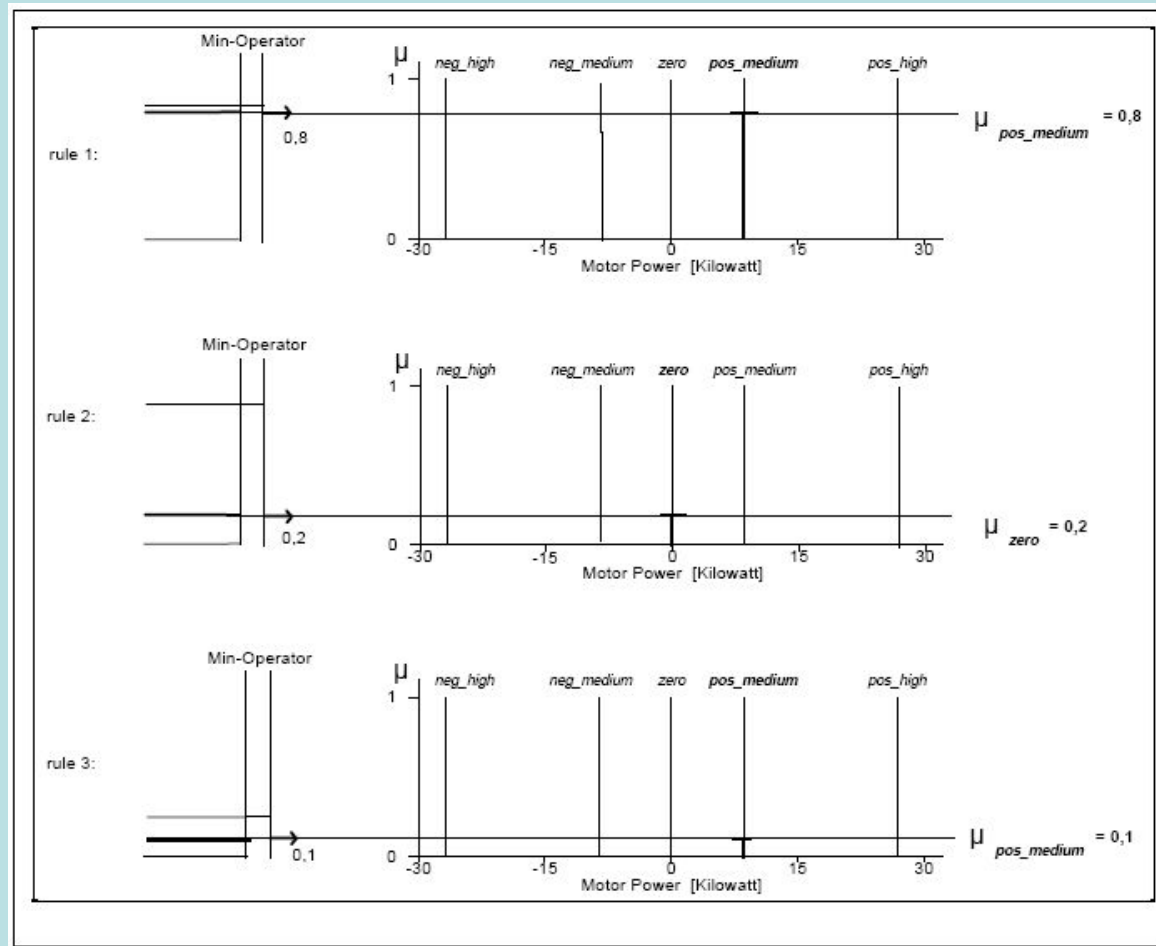
If condition  $P_1$  THEN conclusion  $C_1$

If condition  $P_2$  THEN conclusion  $C_2$

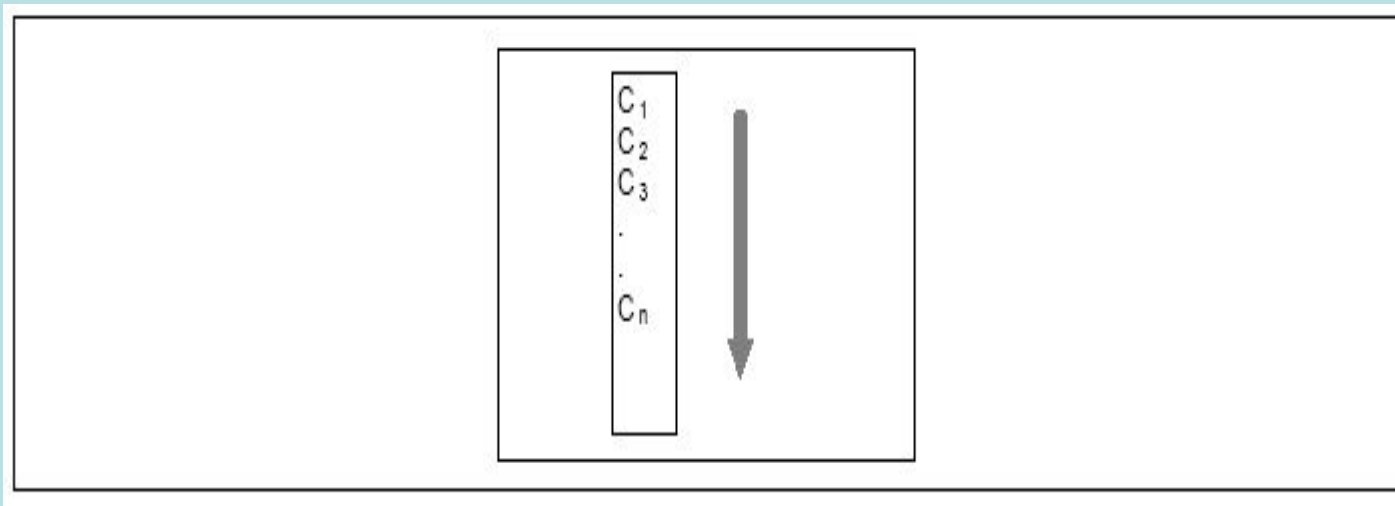
If condition  $P_3$  THEN conclusion  $C_3$

for all rules

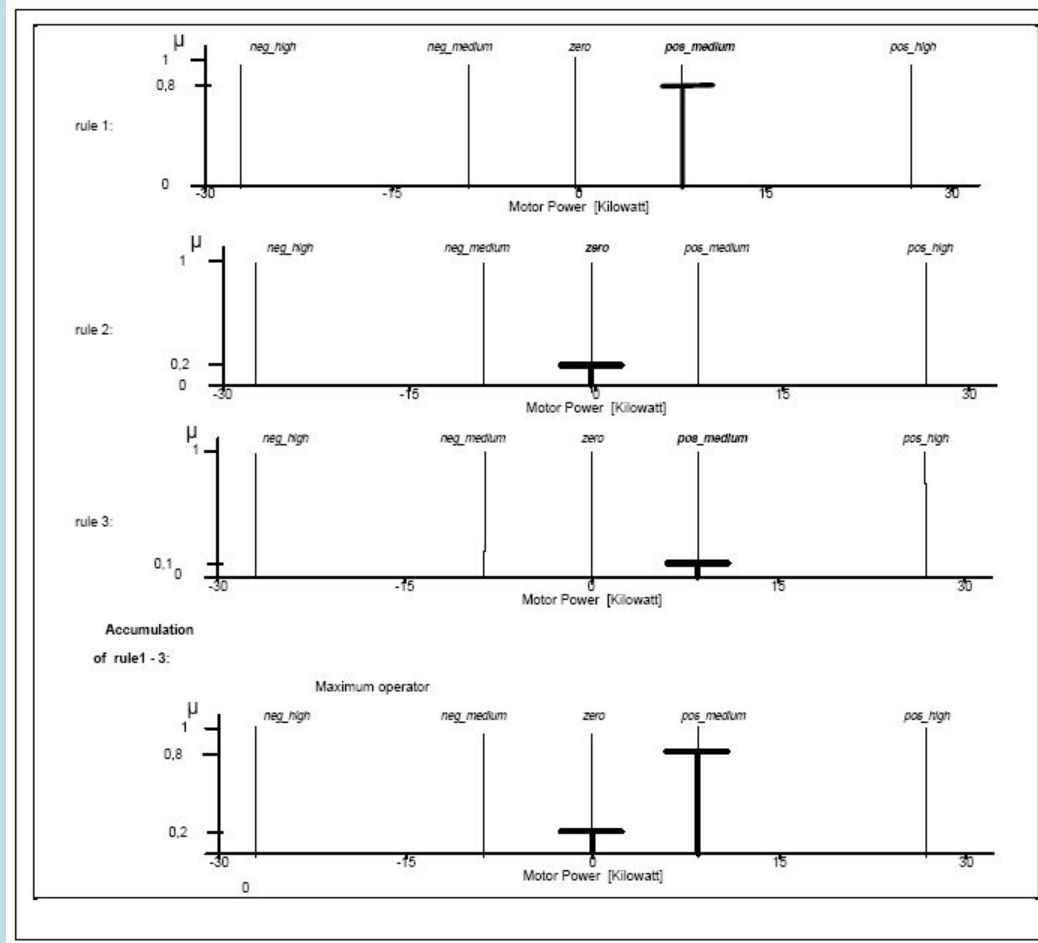
# Нечеткий вывод



# Аккумуляция



# Аккумуляция

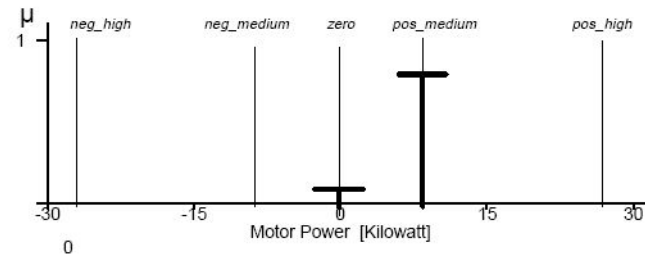




# Дефазификация

## Accumulation

of rule1 - 3:



## Defuzzification Max Height Method

In the Max Height Method, the value of the output variables is determined by the membership function of the output set with maximum degree of membership.

