Driving Control via Fuzzy Logic System

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About

Fuzzy operand
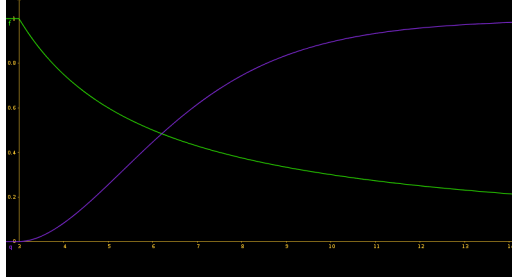
We define that basic fuzzy operands $\wedge$ and $\vee$.

$$a \wedge b = 1 - min(1, ((1-a)^w + (1-b)^w)^{\frac{1}{w}})$$
$$a \vee b = min(1, (a^w + b^w)^{\frac{1}{w}})$$

where we choose w is $\sqrt{2}$

Membership function and Fuzzy Set

Because the radius r of car is 3, we can define these membership functions as below.

Where the Green Function $f(x)$ (**Close**) is

$$f(x) = \begin{cases} \frac{r}{x} & : x > r \\ 1 & : \text{otherwise} \end{cases}$$

and the Purple Function $q(x)$ (**Far**) is

$$q(x) = \begin{cases} \tanh(\log^2 \frac{x}{r}) & : x > r \\ 0 & : \text{otherwise} \end{cases}$$

and use $g(x, y) = (f(x) \land f(y)) \lor (q(x) \land q(y))$ be the **Euqal** of x and y.

And then fuzzy rules are

- If *left* is **close** and *right* is **far** then $\theta = 40°$
- If *right* is **close** and *left* is **close** then $\theta = -40°$
- If *ceneter* is **close** and (*left, right*) is **Equal** then $\theta = w(left, right) * 40°$

where the $w(x, y)$ is

$$w(x, y) = \begin{cases} 1 & : f(x) * q(y) \geq f(y) * q(x) \\ -1 & : \text{otherwise} \end{cases}$$

Finally, use weighted arthimetic mean defuzzier to get real θ.

How to Compile and Run

Environment Required

- `CMake` $>= 3.0$
- `GTK3`
- `Cairo` $>= 1.14$

Configure

`cmake THE_SOURCE_DIR_YOU_PUT`

How to build

`make`

Run

`./auto_mobile`