Supervisory controller (review)

User inputs Information from other systems

Fuzzy supervisory controller

Reference

Controller

Plant

Output

Conventional
Fuzzy
Adaptive
Non-adaptive, etc.

Supervision of fuzzy controllers

Two-link flexible robot (p.125)

Experimental results (FC)

Without payload

With payload

Performance degradation with a payload
**Experimental results: FMRLC**

- Without payload
- With payload

**Fuzzy control system with a supervisor**

Vary the speed of shoulder link gradually to avoid exciting oscillatory modes.

**Rule 1 of a supervisor**

- If $|e_1(t)| > 20$deg Then use Rule-base below and expanded universes of discourse. ("coarse control")

**Rule 2 of a supervisor**

- If $|e_1(t)| < 20$deg Then use Rule-base below and compressed universes of discourse. ("Fine control")
Remarks

- It would be possible to
  - view the premises of the rules as linguistic statements, by defining membership functions.
  - use membership functions to quantify the meaning of consequences.
- Then, the supervisor is a fuzzy system that would gradually, rather than abruptly, switch between the two conditions.

Example

If $e$ is negative, Rule-base 1 applies. If $e(t)$ is positive, Rule-base 2 applies.

<table>
<thead>
<tr>
<th>$e(t)$</th>
<th>$C_1$</th>
<th>$C_0$</th>
<th>$C_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E_1$</td>
<td>-2</td>
<td>-0.5</td>
<td>0</td>
</tr>
<tr>
<td>$E_0$</td>
<td>-0.5</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>$E_1$</td>
<td>0</td>
<td>0.5</td>
<td>2</td>
</tr>
</tbody>
</table>

$e(t) = 0$

Experimental results

- Without payload
- With payload

Summary

- Supervision of direct fuzzy controllers (rule-base and scaling gains)
- Supervision of adaptive fuzzy controllers (adaptation mechanism) is also possible (but omitted in this course).
- What are the elements to be supervised in adaptive fuzzy controllers?
Review

- Fuzzy control
- Fuzzy identification
- Adaptive fuzzy control
- Fuzzy supervisory control

Next week ...
- Neural network
- Genetic algorithm

Announcement

IEEE Control Systems Society Technical Meeting

Speaker: Dr. Carlo Menon, SFU
Title: Biomimetics, new paradigms for (space) robot design
Date & Time: November 14 (Fri), 2-3pm
Place: Kaiser 2020, UBC