

Chapter 1

Introduction

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Fuzzy

- The word “fuzzy” means “not sharp, unclear, imprecise, approximate”.
- Fuzziness occurs when the boundary of a piece of information is not clear-cut.
- Fuzzy vs vague (not specific, amorphous).
- Examples:
 - “see you in a few minutes” vs “see you soon”.

Fuzziness Reasoning

- Real world is too complex!
- Fuzziness introduced to obtain a reasonable model.
- Partial Success with ‘quantitative’ techniques.
- Expert knowledge’ has become too important.
- The fuzziness concept can formulate knowledge in a systematic fashion and give it an engineering dimension.

Crisp vs Fuzzy Set

Crisp (classical) set

- It is defined by crisp (exact) boundaries (i.e. no uncertainty about the location of the set boundaries).
- Either an element belongs to the set or it does not.
- Used in digital system.

Fuzzy set

- It is defined by ambiguous boundaries (i.e. uncertainty about the location of the set boundaries).
- It contains objects that satisfy imprecise properties of membership (degree).
- Used in fuzzy controllers.

Crisp vs Fuzzy Set

Example

- Crisp: Is water colourless? **Yes**

No

- Fuzzy: Is he honest? **Extremely honest (0.3)**

Very honest (0.4)

Sometimes (0.2)

Dishonest (0.1)

Some examples of fuzzy applications

- Fuzzy Washing Machine:

- ✓ The first major consumer product to use ‘fuzzy systems’ (Matsushita Electric Industrial Company in Japan in 1991).
- ✓ The fuzzy system included 3 main input variables (the extent of dirt, the dirt type and the load size), which were measured using optical sensors, and one output (choice of the correct cycle).

Some examples of fuzzy applications

- Fuzzy Control of Subway Train (Sendai Subway in Japan):
 - ✓ Two controllers: Constant speed controller (Starts the train and keeps speed below its safety limit) and Automatic stopping controller (Regulates the speed limit to stop at a target position).
 - ✓ Sample Fuzzy Rules:
 - For Safety
IF the speed of the train is approaching the limit speed, THEN select the maximum brake notch.
 - For Riding Comfort
IF the speed is in the allowed range, THEN do not change the control notch.