

Introducing Fuzzy Logic and Computing with Words Paradigms in Realtime Processes for Performance Arts

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Motivation

Since Computing with Words (CW) fits very well all kinds of human expressions (feelings, perceptions, emotions, impressions, believes, etc.) we are interested in introducing these concepts in the world of real-time processes for performing arts. Our research is based on two concurrent tasks: exploring the necessary concepts in fuzzy logic *being not limited to fuzzy control*; identifying case studies showing the relevance of fuzzy approaches and concepts.

Proposition: *FuzzyLib*, a fuzzy logic library for Max/MSP

This double approach led us to specify and develop our own fuzzy library adapted to real-time formalisms and opened beyond fuzzy control. It is named *FuzzyLib*. At the same time we started using it for precise applications: first, for the semantic control of effects in a theatre play; secondly, for fuzzy filtering and decision in gesture recognition.

FuzzyLib is a library for the realtime environment Max/MSP available on the Internet at <http://imtr.ircam.fr/imtr/FuzzyLib> Three objects have been designed, that correspond to three levels of fuzzy logic: fuzzification, reasoning and defuzzification, fuzzy rule expression.

Fuzzification step

The considered phenomenon (1D-signal in our case) is translated then considered as a linguistic variable. An object named *lv* ('linguistic variable') has been designed to this end (see Fig. 1). A module for linguistic variable and fuzzy subset (FS) graphical display has also been developed, receiving data from the *lv* object and displaying FS and the current value of the variable.

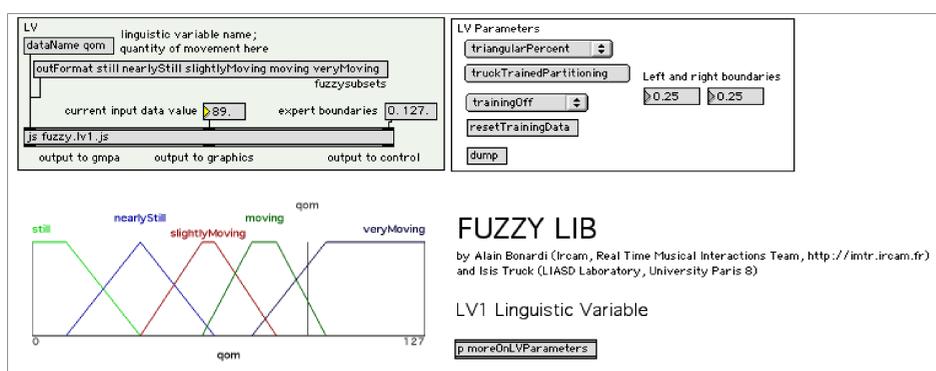


Fig. 1. The 'lv' object

Reasoning step

Reasoning is computed thanks to the generalized modus ponens that enables to solve the following syllogism: if we assume and we get A' close to A as input, what should the answer B' be?

An object named *gmpa* ('generalized modus ponens application') has been developed. It also provides defuzzification for linguistic variables implied as consequents of fuzzy rules. The user has to choose the fuzzy implication (Reichenbach, Lukasiewicz...) and the t-Norm / t-CoNorm to be handled.

Rule composition

We also implemented an interface object named *ruleComposer*, associated with the 'gmpa' object to help users to write fuzzy rules and avoid syntax errors. This object automatically collects the names of the linguistic variables declared with 'lv' objects and provides help to write fuzzy rules. The rules are expressed as Max/MSP messages.

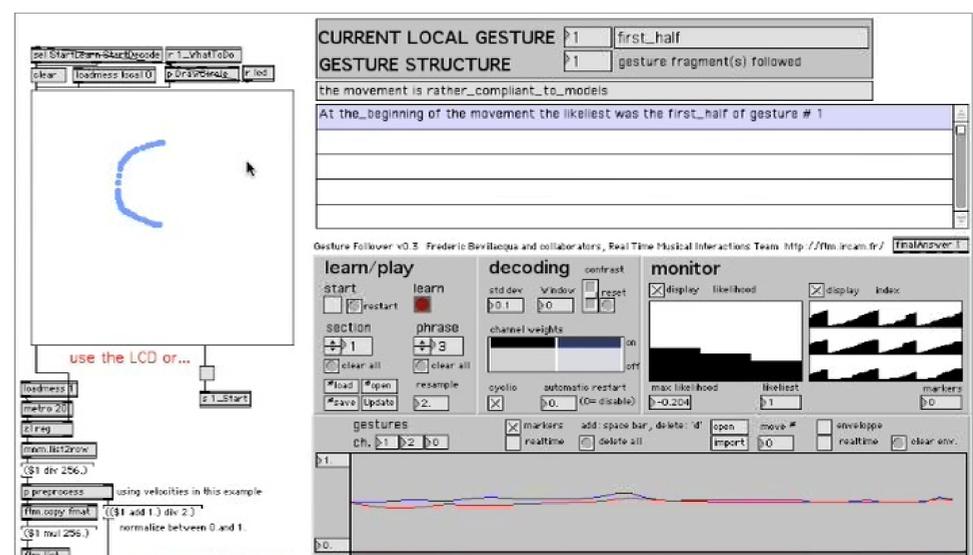


Fig. 2. Recognizing a gesture for a 'c'

HMM gesture recognition

In this case, *FuzzyLib* enables to filter with fuzzy decisions non-significant fragments of gestures, and to provide for a synthetic semantic abstract of the gesture.

E.g., we have learnt three characters in the system: 'c', 'o' and 'b'. Fig. 2 shows the abstract generated when drawing a 'c': "At the beginning of the movement the likeliest was the first half of gesture #1" (gesture # 1 is 'c'). It is a kind of *semantic overview of the gesture*.