Use of the domination property for interval valued digital signal processing

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WHAT IS LINEAR FILTERING?

\[ y(t) = \sum_k (x_k \ast \kappa_k)(t) \]

\( \kappa \) is the impulse response of the filter

\( \kappa \) summative kernel: \( \sum_n \kappa_n = 1 \)
**Find the impulse response** ... can have a drastic influence on the processed signal ...

We propose a way to induce a kind of robustness in signal processing by representing the convex hull of all outputs of a whole set of coherent filters.

... and sometimes it can be difficult to specify the right impulse response!
DIFFERENT WAYS TO EXPRESS CONVOLUTION

- $y_n = \sum_k x_k \kappa_{n-k}$
- $y_n = \sum_k x_k \kappa^n_k$  \(\kappa^n\) is the kernel \(\kappa\) translated in \(n\)
- $y_n = \mathbb{E}_{P_{\kappa^n}}\{x\}$  \(P_{\kappa^n}\) is the probability of being in the neighborhood of \(n\) (via \(\kappa\))

... thus a set of kernel is equivalent to a set of probability ... i.e. a credal set.
PRACTICAL REPRESENTATION

- possibility distribution (maxitive kernels)
- clouds (cloudy kernels)
- pi boxes
- ...

\[ M(v) = \{ P \text{ (probability)} / A \subseteq \Omega, P(A) \leq v(A) \} \]
HANDLING EPISTEMIC UNCERTAINTY

- Partial knowledge due the need of an expert to identify a model (Loquin and Dubois)
- Partial knowledge due to poor information on the state of the considered system (Laâmari et al.),
- Partial knowledge due to inherent vagueness of the natural language (Lawry),

HOW TO REPRESENT WHAT HAPPEN TO A RANDOM VARIABLE WHEN IT GOES THROUGH AN ILL-KNOWN SYSTEM?
How to combine in a single model epistemic uncertainty and random variations (due to observation)?
How to keep low-computational complexity?
How to provide results that can be easily interpretable?
How to access to information of this partial knowledge?
How to compare the new methods we propose to more traditional methods (especially when comparing bipolar to unipolar or interval-valued to single valued)?