WORK IN PROGRESS:
Adaptive-Reactive Cooperative System for Object Identification

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Outline

Introduction

- Identification System
- Cooperative System

Cooperative Model

- Selection Algorithm: Previous Solutions
- New Proposals:
  - Particle Filter-based Approach
  - Contributions-based Approach
Identification System

- Radar device for identifying.

**HARDWARE**
- Radar device
- DSP-based platform for processing radar signal

**SOFTWARE**
- Time & Frequency analysis
- Expert system: Classification Tree

- Radar location
- Object trajectory
- Training set

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Streetlamps management

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COOPERATIVE SYSTEM

Multiple signals

Radar signal for system 1
Radar signal for system 2
Radar signal for system n

Classification tree
(The same for all systems)

System 1 identification result
System 2 identification result
System n identification result

HYPOTHESIS SET

Selection algorithm

NETWORK

COOPERATIVE identification result

HYPOTHESIS SET
Weights modification is always done using a fixed value defined by the programmer.

Majority Voting

Weighting allows to define the impact of each partial identification and to consider past experiences (learning).

Different reward/penalization procedures were analyzed.

New proposals: Particle Filter

- Particle Filter based Solution

Estimate the future state of a dynamic system

Based on the Montecarlo method

Set of particles. Each one represented by a duo (value & weight).

Particles move towards the converge zone according to the previous weights.

- Particle Filter based Method

Number of subsystems: \( n \)-dimensional space

Particle weights are not considered

Particles are valid or invalid (i.e. according to the cooperative solution)

New particles are placed close to the valid particles.

The axes represent the weights assigned to each subsystem.

Tridimensional space implies 3 subsystems. Each particle is represented by 3 weights.
New proposals: Particle Filter

- Particle Filter based Solution
  - Standard Particle Filter

- Particle Filter based Method
  - Number of subsystems: *n*-dimensional
  - Particles are valid or invalid (i.e. according to the cooperative solution)
  - Each subsystem has to deal with its own particle filter.
  - The final solution is given by the most repeated category.

Weights (particles) represent past experiences

- Just one particle filter.
- The final solution is given by the most weighted category.

Coordinator

- Majority criterion
  - Most repeated object

Particle filter

- Contribution analysis
  - Most weighted object
New proposals: Contributions based on probabilities

- Contributions-based Procedure

  Probability of failure of the last i-evolutions ($\beta_m$)

  Contribution of the subsystem $m$:
  \[ \Delta = \square - \square \]

  \[ \beta_m : \text{Varies between 0 and 1} \]

  \[ \Delta_m : \text{Varies between 0 and 0.6321} \]

  $\beta_m$ is updated depending on whether the solution of the subsystem matches the cooperative solution or not.

  The category that has higher contribution is the cooperative solution.
THANK YOU FOR YOUR ATTENTION