ModEasy: Technical meeting on application

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Participation

- **IEMN**:
  - Atika Menha-Rivenq
  - Leila
- **LIFL**
  - Ouassila Labbani
  - Philippe Marquet
  - Eric Rutten
  - Arnaud Cuccuru
  - Yosri Miled
  - Ahmed Jerbi
  - Luc Charest
  - Sébastien Le Beux

Objective

This first meeting target an information exchange on several application aspects.

Chapter 1

Presentation from University of Valanciennes

1.1 Current application

Atika has summarize some principle of radar application. Their main objective is the computation of distance between two objects. From this distance, it is possible to obtain more information, like the speed of one object according to the speed of the other one.

An object can be a railway train-wagon, where the wave propagation is guided and where two objects can communicate. In other context, object can also be a car. In that case, their is no possible communication (because all cars are not necessarily equipped of radar). Thus, car using radar compute distance between it and an object of its environment (other car, object on road...). Hence, relative speed can be compute...

Principle: Radar emits waves which contains information particular to both, the radar and the wave. This information is a series of 127 bits. To detect an obstacle, received signal and emitted one are multiplied in order to find, within the received wave, the information transmit by the radar. A ≪ peak ≫ means that their is common points between emitted and receipt wave, thus an obstacle has been detected

A first application of object detection has been developed and tested by University of Valanciennes. This application is based on computation using correlator algorithm. Application has been implemented on Xilinx FPGA, which maximum frequency is 30 MHz.

Chapter 2

ModEasy project

2.1 Algorithm

Concerning the Modeasy project, a new algorithm will be develop. It is HOS (Higher Order Statistics) algorithm, from order 3 or 4, depending on precision needed by the user. Order 3 and 4 means that there is the need to do 3 or 4 sets of multiplications during computation of object detection (previous algorithm, based on correlation computation, was a HOS of second order). This new algorithm permits a better precision on obstacle detection.

2.2 Radar

Furthermore, in order to increase again precision of obstacle detection, a new radar will be use.

2.3 Targeted FPGA

As needed computation power grows, a new FPGA will be used. Altera (which propose analog input on certain chip) has been chosen for the next implementation of the new algorithm. Its higher frequency is 150 MHz.

2.4 Possible others works

Until now, there is no interface between the radar device and the central processor of the car. The CAN standard should be used in order to transfer the relevant information. Information that should be transferred on this bus has to be chosen.

GPS can be coupled to the anti collision radar to compute other information and to take decision.

The current algorithm is able to detect obstacle according to emission from the vehicle. Nothing else was taken into account. In case where safety barriers were equipped of emission system (with its own code), it is possible to do other computation in order to detect them. Thus, from the same entry, two computations can be done.

2.5 Discussion/proposition?

As there exist different algorithms implementable, with their own advantage in different contexts, it is interesting to keep flexibility in application. This flexibility should permit to select which algorithm to implement, according to the context. A proposition put forward which enable this flexibility is the use of a State Machine which control implementation of the four different algorithms. Each state corresponds to the implementation of selected algorithm on reconfigurable architecture. Ouassila should work on this control aspect.

Output of the implementable algorithm is the result of computation of received signal and internal signal. With the result of this computation, it is possible to estimate distance between the car and a potential obstacle. This estimation requires few computation. From several distances computed in different time, it is possible to estimate relative speed of a detected obstacle. Within the speed of car using radar, it is possible to compute real speed of detected object. From this speed, acceleration and deceleration of detected object are computable. Thus, making prediction comes to be possible. This predication should be an action on car comportment, like deceleration of the car.

One job of LIFL will be the extraction of repetitive aspect of the tasks. For example, computation of first elements using 1023 entries is fully parallel. But, others elements can be based on repetitive structure. At the end, all extraction of parallelism structure will permit a compact description of a lain application in UML.

Chapter 3

Resumed on Gaspard models

Arnaud has presented an example of intensive signal processing task model in UML. Modeling of this repetitive task can be expressed in a compact way, using ArrayOL. From this model, he has explain how to express temporal dependencies.

From this example and the algorithm presented before, a first solution of modeling with three table has been sketched:

- received signal;
- reference signal;
- computed value.

Definition of the first prototype has been reported to the next meeting.

Chapter 4

Next meeting

- **Date: 9 June 2005**
- **Work to do:** Jamel (from Valanciennes) has to prepare report on radar algorithm. This report should mainly contain several information on **structural** aspect of application.