



NU-SpECS project aims to acquire new DSP technologies in order to improve Leaff's NU-Tech Framework. In particular NVIDIA® CUDA™ technology and ALIZE Speech Engine Toolkit have been selected. *NU-SpECS* is a 16 months project and started on February 2009. Politecnico di Milano (Italy) and University of Avignon et des Pays de Vaucluse (France) have been involved together with two young PhD students.

1 Leaff

Leaff is an Italian SME with strong innovative R&D capabilities for delivering, by a consolidated team of expert developers, high quality digital signal processing applications and consultancy services for custom tools and solutions. A deep link with the academic world guarantees up-to-date know-how, established by several papers published in international conferences. Several consultancy projects for large multinationals as well as small local companies have been carried out through the years. Leaff usually works with many partners as part of their supply chain. The need for developing reusable software components that are efficient, flexible, easy to use, and easy to integrate led Leaff to the NU-Tech Framework development. Leaff's solutions for its customers are all NU-Tech based.

2 NU-Tech

NU-Tech represents a powerful DSP platform to validate and real-time debug complex algorithms, simply relying on a common PC and a soundcard (use ASIO for strict control over latencies). Thanks to an easy plug-in architec-

ture, the developer can write his own NUTSs (NU-Tech Satellites) in C++ and immediately plug them into the graphical interface design environment. Main modules are: ,

- ★ *NU-Remote*: a “remote control” mode allows the discovery of other NU-Tech applications on the network. The user can connect to a remote Board which is locally virtualized and easily control it. Eg. European Project *hArtes* CarLab running a NU-Tech framework based application.

- ★ *NU-Sync*: a guided procedure to keep NUTS libraries synchronized between different NU-Tech applications on the same network. Fast and easy redistribution of new NUTS.

- ★ *NU-Modules*: a powerful set of APIs can be used to control NUTS graphs and perform complex tasks. NU-Module provide a straightforward solution to build stand-alone apps or drive automated procedures.

- ★ *NUKe (NU-Tech Kernel)*: the compact NU-Tech engine portable to different platforms on request. No GUI for maximum performances.

Beam-forming, line-array speakers, AEC, multichannel automotive audio systems etc. . . are examples of scenarios where NU-Tech adds a real boost in terms of TTM.

3 The Project

NU-Tech modular architecture let integration process of third party technologies easy and straightforward. Two main technologies have been selected to be integrated in NU-Tech. The technology transfer process have been selected in order to realize the objectives of the project: two different international scientific partners with established skills and knowledge on these particular technologies have been involved.

3.1 NVIDIA® CUDA™

NU-Tech main advantage is to use a common PC as an economic and flexible workbench for DSP applications developing. This could also represent a limitation if a huge computational power is required and a PC does not suffice anymore. Aim of the project is to overcome this limitation thanks to CUDA™ technology and let the platform be used for a number of applications which were precluded till now. NVIDIA® CUDA™ is a general purpose parallel computing architecture that leverages the parallel compute engine in NVIDIA® graphics processing units (GPUs) to solve many complex computational problems in a fraction of the time required on a CPU. To program to the CUDA™ architecture, developers can, today, use C, one of the most widely used high-level programming languages, which can then be run at great performance on a CUDA™ enabled processor. Other languages will be supported in the future, including FORTRAN and C++. With over 100 million CUDA™-enabled GPUs sold to date, thousands of software developers are already using the free CUDA™ software development tools to solve problems in a variety of professional and home applications from video and audio processing and physics simulations, to oil and gas exploration, product design, medical imaging, and scien-

tific research. With over 100 million CUDA™-capable GPUs already deployed, thousands of software programmers are already using the free CUDA™ software tools to accelerate applications. CUDA™ can be integrated into NU-Tech into three different ways:

1. Creating a CUDA™ compliant functions library for NU-Tech. The developer does not have to change his way of programming. He could use them transparently without any knowledge of CUDA™ programming techniques and at the same time take advantage of CUDA™ performances improvements.
2. Creating CUDA™ NUTSs: NU-Tech satellites whose computational tasks would be managed by the GPU through CUDA™ technology. NU-Tech developer would have the chance to chose whether to take advantage of these new NUTS to increase his application performances.
3. Creating a logical layer able to interpret code written for CUDA™. A NUTS can be written in C/C++, advanced users who can write code for CUDA™ platform can insert it in NUTS code and let NU-Tech handle it appropriately.

Aim of the project will be to implement the best way to improve NU-Tech through CUDA™ integration.

3.2 DEI

The “Dipartimento di Elettronica e Informazione” of Politecnico di Milano, Italy, known as “DEI”, is one of the major university departments in Europe, both for its size and for the quality of its research. Its mission is to improve constantly the scientific and technological knowledge in the fields of Systems and Control, Computer Science and Engineering, Telecommunications, and Electronics.

With over 600 members, researchers, collaborators, PhD students, technical and administrative staff, the Department is a vital institution capable of promoting education, fundamental and applied research, and technology transfer to companies. The quality of the research work is demonstrated by the broad network of partnerships with the best international institutions, which makes the Department one of the fundamental players in the worldwide scenario of scientific and technological innovation. The orientation towards the future goes together with a tradition of excellence matured in over 60 years of activity. The result is an environment favourable to the growth of talented people, to the creation of new ideas and enterprises, to the collaboration with private companies and public institutions. The NVIDIA® CUDA™ technology is being taught at universities throughout the world, helping the development of innovative solutions to some of the most complex computation-intensive challenges. DEI is the only Italian academic institution which applied to NVIDIA® professor partnership program.

3.3 ALIZE Toolkit

Speaker recognition technology is no longer stuttering which means huge opportunities for established players and newcomers alike. Advances in processing power, new software algorithms, and even better microphones have enabled established players and a raft of startups to design systems that work - with an accuracy rate higher than 97%. And they're creating explosive potential for growth in markets for everything from handheld dictation devices to mobile phones to auto parts to battlefield translators. The overall market for voice-recognition technology topped \$1 billion for the first time in 2006, a 100 percent increase in just two years. ALIZE is a software platform that aims to facilitate application devel-

opment in the speech and speaker recognition field. ALIZE is developed at the Laboratoire d'Informatique d'Avignon (LIA) under the direction of Jean-François Bonastre since February 2003.

Aim of the project is to integrate ALIZE functionalities inside NU-Tech Framework in order to use it for speaker recognition application developing.

3.4 LIA

The LIA (Laboratoire d'Informatique Avignon) is a Research unit of Higher Education (UPRES No. 4128) which brings together the faculty of the University of Avignon et des Pays de Vaucluse (UAPV), France, under the CNU section of the 27th and the Ph.D. students and trainees MASTER during the period devoted to their research work. Professor Jean-François Bonastre of LIA, Université d'Avignon is the Coordinator of the ALIZE Project.

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