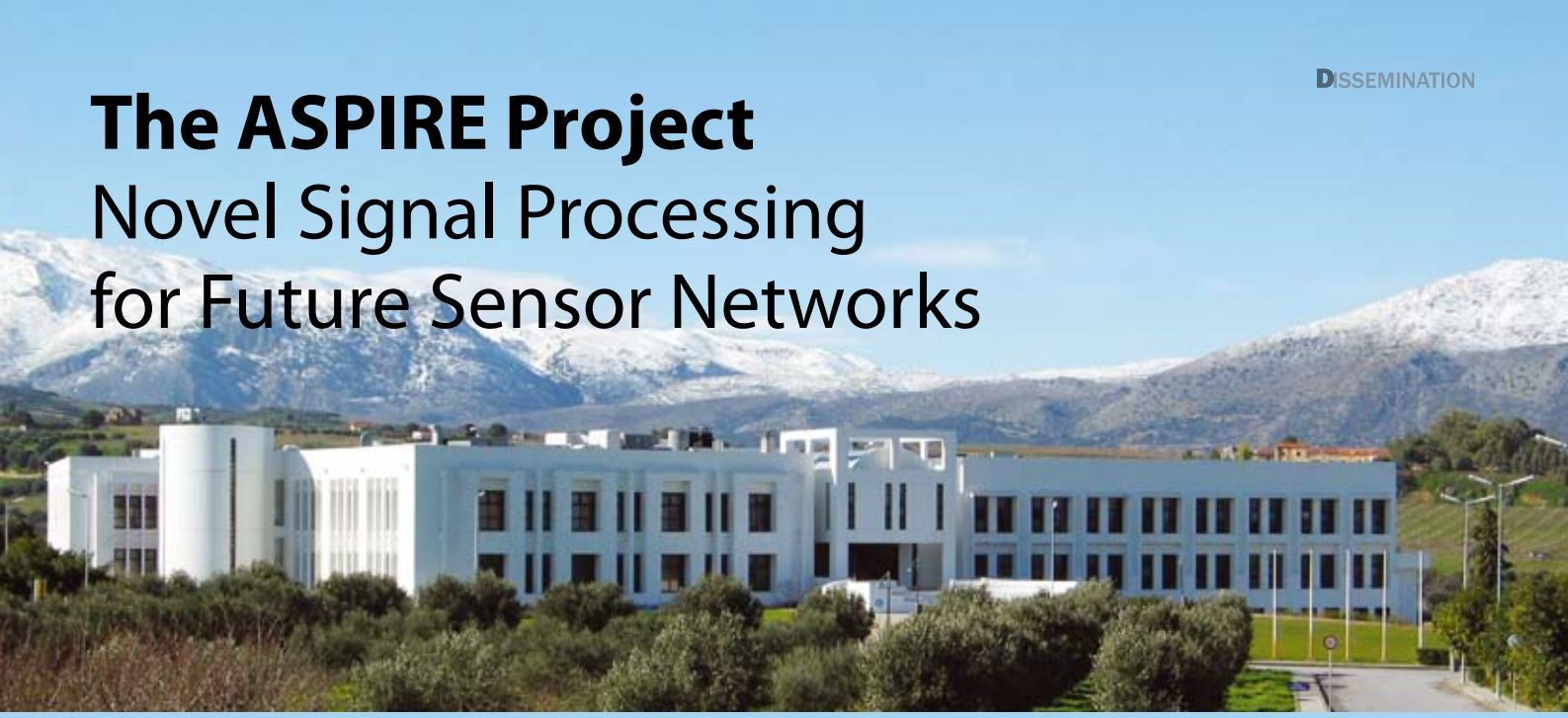
The ASPIRE Project
Novel Signal Processing for Future Sensor Networks



Wireless sensor networks are an emerging technology with a goal to monitor the physical world by means of a densely distributed network of wireless sensor nodes. With WSN it will soon become feasible to deploy substantial amounts of inexpensive devices to observe large ground surfaces, underwater regions, and areas in the atmosphere.

What is the ASPIRE project?

Realizing the potential of large, distributed wireless sensor networks (WSN) requires major advances in the theory, fundamental understanding and practice of distributed signal processing, self-organized communications, and information fusion in highly uncertain environments using sensing nodes that are severely constrained in power, computation and communication capabilities. The European project ASPIRE (Collaborative Signal Processing for Efficient Wireless Sensor Networks) aims to further basic WSN theory and understanding by addressing problems including adaptive collaborative processing in non-stationary scenarios; distributed parameter estimation and object classification; and representation and transmission of multichannel information. This highly diverse field combines disciplines such as signal processing, wireless communications, networking, information theory and data acquisition.

In addition to basic theoretical research, ASPIRE tests the developed theories and heuristics in the application domain of immersive multimedia environments. Indeed, art, entertainment and education have always served as unique and demanding laboratories for information science and ubiquitous computing research. The ASPIRE project explores the fundamental challenges of deploying sensor networks for immersive multimedia, concentrating on multichannel audio capture, representation and transmission. The techniques developed in this project will help augment human auditory experience, interaction and perception, and will ultimately enhance the creative flexibility of audio artists and engineers by providing additional information for post-production and processing.

Immersive audio, as opposed to multichannel audio, is based on providing the listener with the option of interacting with the sound environment. This translates to listeners having access to a large number of recordings that they can process and mix themselves, possibly with the help of the reproduction system using some pre-defined mixing parameters.

So far, we have introduced mathematical models specifically directed towards facilitating the distributed signal acquisition and representation problem, and we have developed efficient multichannel data compression and distributed classification techniques. In the multisensor, immersive audio application, we tested and validated novel algorithms that allow audio content to be compressed and allow this processing to be performed on resource-constrained platforms such as sensor networks. The methodology is groundbreaking, since it combines in a practical manner the theory of sensor networks with audio coding.

In the future, we hope to implement exciting new ideas; for example, immersive presence of a user in a concert hall performance in real time, implying interaction with the environment, e.g., being able to move around in the hall and appreciate the hall acoustics; virtual music performances, where the musicians are located all around the world; collaborative environments for the production of music; and so forth. It is certain that the home and work environments of the future will be significantly enhanced by immersive presence, including entertainment, education and collaboration activities.

ASPIRE is a €1.2M Marie Curie Transfer of Knowledge (ToK) grant funded by the EU for the period September 2006 to August 2010. The University of Valencia, Spain and the University of Southern California, USA are valuable research partners in this effort.

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