Significant Research Contributions of Prof. Lalit Mohan Patanaik

Prof. Patnaik has made several pioneering contributions in the broad discipline of Computer Science and Engineering. His outstanding research work spans several areas such as High Performance Computing, Soft Computing, Computer Aided Design of VLSI Circuits, Mobile Computing, Computational Neuroscience, Medical Imaging, Information Retrieval and Security including Data and Web Mining. A brief summary of his significant research results is presented below.

High Performance Computing:

One of his pioneering contributions has been the design of an intelligent configuration of hierarchical network of hypercubes called the Extended Hypercube (EH), a highly efficient message passing architecture. Accelerated neural network simulators have been developed using this novel architecture, to yield better performance than some of the best commercial approaches. He has developed modified version of Pixel-based reconstruction (PBR) algorithm for three-dimensional medical imaging and ported this algorithm onto the above EH architecture to yield excellent performance improvement. He has played a significant role in evaluating the performance of India's supercomputer PARAM.

Soft Computing:

The focus of Prof. Patnaik's original research in this area has been on theoretical and practical fronts.

He has developed a novel exact model for analyzing the working of Genetic Algorithms (GAs), when the objective function is a function of unitation and population is infinite. The concept of fitness of moments developed by him to analyze the working of GAs and characterizing their dynamics is ingenious. His original concept of adaptive probabilities of crossover and mutation to realize efficient multimodal function optimization has been extensively used in VLSI channel routing, testing, and physical design. For the first time, he has applied genetic programming to multicategory pattern classification.

His recent work on computational neuroscience has been widely acclaimed by neuroscientists and doctors. He has intelligently used several pattern classification techniques and feature extraction methods to classify MRI, fMRI images and EEG signals to diagnose several brain disorders and carry out cognition studies.

Mobile Computing:

He has developed a significantly novel distributed channel access protocol that occupies the channel reservation and the iterative/global transmission power control schemes in wireless adhoc networks. His novel energy-efficient routing algorithms, address allocation strategies,

resource allocation policies, and location tracking techniques developed for wireless networks are widely acclaimed by researchers and industry practitioners.

Computer Aided Design of VLSI Circuits:

He has developed a novel test-set selection technique based on the frequency domain testing of analog circuits. This novel technique is best suited for use of existing building blocks in systems-on-chip for implementation of an on-chip test-signal generator and test response analyzer. For digital circuit testing, he has proposed a new coverage metric for delay fault tests. He has developed novel parallel algorithms and architectures for placement, routing, circuit simulation, and testing of VLSI circuits.

Real -Time Systems and Control:

Prof. Patnaik's applied skills in the area of real-time multivariable computer control have been demonstrated through his novel direct digital and supervisory control algorithms for ammonia reactors in fertilizer plants, steel, and nuclear industries. His self-tuning control algorithms yield improved performance for process industries.

Some of his noteworthy projects for the strategic sectors in India are, Real-Time Scheduling Algorithms for Onboard Computers for Indian Satellite Launch Vehicles, Automatic Target (Missile) Recognition, Multi Sensor Data Fusion for Onboard Radars, Space Time Adaptive Processing for Onboard Radar Signal Processing, and Online Nuclear Fuel Rod Positioning.