



PENTAGRAM RESEARCH CENTRE PRIVATE LIMITED

Mission: ...In the service of the Nation

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(A registered company by the Indian companies act, 1956)

This company was known by the name Pentagram Research Corporation since 1993, and it has a number of Scientists and Engineers who are working in pure and applied research. So far, more than 100 original research papers were published by our Scientists. The company was recognized by the Systems, Man and Cybernetics society of the IEEE, U.S.A., and some of the software products were displayed during the 1995 IEEE International Conference on SMC held at Vancouver Canada. Later in **February 1997**, the company was incorporated as a **private limited company** under the 1956 Indian Companies Act.

This research company was incorporated as a non commercial organization by Professor Rajan with the idea of inculcating research interests among faculty, students and industrialists who were known to him then. However, as activities increased, the company decided to go commercial and it started exploring the possibilities of commercializing concepts, paradigms and products and of conducting funded research and of developing especially software products. Some details are highlighted below for ready reference by any one concerned:

Original concepts introduced since 1984

Sl. No.	Concept	Description	Applications
1	Constructive Theory of Signals and Systems	This theory was evolved in 1984 as a paradigm for the study of signals and systems. Markov's Normal Algorithms play a dominant role in this theory. The central idea is that signals are treated as subsets of free monoids and systems as string manipulating normal algorithms.	This theory forms a basis for symbolic computation and Natural Intelligence modelling.
2	EFS(spl(A))	An Elementary Formal System developed for the formal study of non-numerical signal processing.	Formal study of symbolic computation.
3	M-grammar	A grammar that connects Turing machines and Markov's Normal Algorithms by finitely specifying infinite systems which are called End justified Post-Turing (EPT) rewriting systems.	Connects Chomsky's hierarchy of languages & Russian constructivism.
4	Lindenmayer Systems and their use in parallel processing of signals	A novel approach to signal processing using Lindenmayer's parallel grammars.	Evolutionary type of non numerical signal processing.
5	Th(k)	A logio mathematical theory for signal analysis developed in the heirarchical symantical system of languages called 'yah' due to A. A. Markov.	Model theoretic approach to the theoretical study of signals and systems.
6	Generalised Markov Algorithms (GMA)	The concept of Markov's Normal Algorithms which are applicable only to linear strings of symbols was extended to multi-dimensional arrays of symbols also. The GMA introduced is a variant of Caracciolo-de Formio's S-GMA and CF-GMA.	Implementation of parallel processing systems using sequential processors.



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7	Constructive Sets	This concept of constructive set was introduced in 1986 as a verboidal transcription defined over the alphabet $A = \{ 0, 1 \}$. This led to the formulation of Algorithmic Sets, Constructive function spaces and normal algorithmic operators.	Constructive sets, Artificial Intelligence Constructive theories based on sets, functions and analysis
8	Constructive Filters	These are extended topological filters developed based on the notion of Constructive Sets.	Model theoretic study of systems
9	Cellular Logic Array Processing (CLAP)	This concept was introduced in 1990 combining the notions of GMAs and Von Neumann's Cellular Spaces. CLAP is an idealised paradigm in which many high-throughput image processing algorithms have been developed.	Pattern directed array processing of signals and images
10	Geometric Filters	Constructive filters developed over von Neumann window. Geometric filter bases are used as image processing operators. A novel image algebra was developed based on these filters.	Signal theory, Image algebra, Modeling and simulation
11	Pextrum	Picture Spectrum is referred here as Pextrum. This is an extended notion of signal spectrum but based on geometric filters and image algebra. Pextral representation of 2D and 3D digital images is an important outcome of this research.	Image compression, Shape recognition and analysis, Solid modeling
12	Representation and processing of digital images on hexagonal grid of pixels.	Introduced with the idea of getting better rotational symmetry. The concept of geometric filters and image algebra have been remoulded for hexagonal grid of pixels.	Lattice Gas Automata studies, Radar image processing, Digital version of PPI scopes
13	Morphological Image Processing in Hexagonal Digital Grid	Digital morphology extended to 3D grid and hexagonal grid images.	Set theoretic approach to the study of complex shapes and structures
14	Intelligent Control using Constructive Logical Methods	A paradigm developed in 1997 to model collision processes and to model autonomous mobile target seeking systems.	Space Surveillance, Missile Technology, Mission critical control
15	Rajan Transform (RT)	A non linear transform introduced in 1997 which has been identified as a powerful spectral domain pattern recognizing tool. RT is used for character recognition, object recognition, data encryption and for hidden watermarking of digital images.	Signature verification, Component sorting, Object identification, Non destructive testing, Image encryption
16	Cellular Automata Modeling of Uni-directional Fluid Flow	Fluid mechanics reviewed in terms of geometric filters. This is a variant of ILG-LG hybrid lattice gas model for two-phase flow simulation.	Flow analysis in nuclear reactors, Jet flow study, Flame analysis
17	Filter Automata	Cellular automata viewed as IIR and FIR digital filters.	Non numerical discrete Signal processing
18	Modeling & Simulation of Solidification and Aggregation using	A novel method introduced to model thermal processes, especially the solidification process of uniform and non uniform metals.	Crystal structure study Fabrication methods of Fiber reinforced castings



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19	Machine Vision Aided Component Sorting	RT is used to sort components in an automated factory.	Automated industries, Flexible manufacturing
20	Constructive Genetic Algorithms (CGA)	Genetic algorithms studied in the framework of Markov's Associative Calculus. CGA is used to fix attack point in a moving target for intelligent homing systems.	Seeker head design for a homing system, Genetic computing, DNA computing
21	Neural Automata Based Object Recognition	Neural automaton is also called cybernetic machine. This concept has been evolved using the properties of cellular automata, genetic algorithms and neural network. Neural automata are trained in RT for pattern recognition purposes.	Electronic Support Measures, Electronic Warfare, Intelligent weapon systems DNA computing
22	CLAPGIS- an integration of GRASS (U.S.Army Product) with CLAP	GRASS is a U.S Army public domain product. This package (version 4.1) was integrated with CLAP image processing algorithms	Remote Sensing & GIS Forest Resources Analysis and Support
23	Flexinet	A novel networking concept which advocates genetic algorithms and cellular automata instead of optimisation techniques and queuing theory for its study.	Fast Teletraffic, High-Speed Internet, Road Transport System Non linear systems
24	Text embedding of digital images	Generally, hidden watermarking of digital images employs a binary pattern (signature) embedding, whereas text embedding advocates the mutation type of changes in the RT spectrum of an image, the changes being related to the alpha-numerals by a coding morphism.	Image transmission with embedded text, HDTV, Police crime records Secured Banking Electronic Commerce
25	Transaction Automation	Fast algorithms for checking the genuineness of varieties of currency notes. Use of IRIS detection methods as bio security measures in ATMs and other money transacting machines.	Successfully incorporated for checking Rupee Euro and Dollar currencies.
26	Codon Spectrum	A new concept developed for studying genome strings (Gene Regulation)	Used for Genomic Signal Processing