



## **Publications relevant to Neuro Signature System**

Axxonet System Technologies has licensed the B.S.P / B.E.O.S technology from Prof. C.R. Mukundan, to build our Neuro.Signature.System.

A list of peer reviewed scientific publications (underlined), and publications after reviewed presentations in seminars and conferences by Prof. C.R. Mukundan and others are given below. These published papers have used relevant frequency and time domain EEG analysis technology, which the author has used in developing the scientific basis of oscillation analysis and time domain changes employed in the Neuro Signature Profiling program. There are more than 700 peer reviewed publications, which must be read and understood for a comprehensive understanding of the rational and techniques applied in the development of various electrophysiological and neurocognitive techniques used in the development of Neuro Signature profiling used for forensic applications. Brief reviews of the findings in these studies and their Meta-analysis are available in authors book "Brain Experience" (2007).

The unique aspect of the Neuro Signature program is based on the original findings of Neurocognitive and Neuroexperiential changes observed during remembrance of experiences and the unique combination of mathematical and statistical treatment of the electrophysiological data applied for interpretation of bioelectric oscillations, which are applied for forensic interpretations. The program allows automatic analysis of the wealth of electrophysiological data based on the predefined algorithm of neurocognitive processing.

### **Internationally and nationally published peer reviewed Studies on EEG frequency-time analysis, from which the Neuro Signature analyses were adapted and developed:**

1. Mukundan CR (1986). Computed EEG in schizophrenics. Biological Psychiatry, 21: 1225-1228.
2. Mukundan CR (1986) Middle latency components of evoked potential responses in schizophrenics. Biological Psychiatry, 21: 1097-1100.
3. Mukundan CR, J Singh, Ray RR, Nimesh Desai (1986). Bereitschaftspotential in alcoholics. Biological Psychiatry, 21: 1090-1092.



4. Mukundan CR, Gonzalvez, CJ, Rao SL, Deepa M, & Veena E (1989). Changes in the amplitude spectrum of fast EEG frequencies in cognitive processing. *Pharmacopsychologia*, 2, 49-56.
5. Mukundan CR, Narayana Reddy, Hegde AS, Jayathi Shanakr (1990). Effects of long term recovery on the middle latency components of evoked potential responses. *Pharmacopsychologia*, 2,49-56.
6. Mukundan CR, Ramachandra S, Sign S, Sharma M, Kamaraj C (1999). Brain mechanisms of hypnosis: P300 studies. *Indian Journal of Clinical Psychology*, 26, 1, 13-23.
7. Annet C, **Mukundan CR**, (1996). Social drinking – part-II : Auditory evoked potentials, P300 responses and contingent negative variation in social drinkers, *NIMHANS Journal*, 14 (1) 22-30.
8. George MR, Potts G, Kothman D, Martin L, **Mukundan CR** (2004). Frontal deficits in alcoholism: an ERP study. *Brain and Cognition*, 54(3):245-7.
9. Khanna S, **Mukundan CR**, Channabasavanna SM (1985). Obsessive compulsive disorder: is it a problem of complex motor programming ? *Indian Journal of Psychiatry*, 29: 41-47.
10. Khanna S, **Mukundan CR**, Channabasavanna SM (1989). Middle latency evoked potentials in melancholic depression. *Biological Psychiatry*, 25, 494-498.
11. Khanna S, **Mukundan CR**, Channabasavanna SM (1989). Middle latency evoked potential responses in obsessive compulsive disorder, *Biological Psychiatry*, 25, 980-983.
12. Khanna S, **Mukundan CR**, Channabsavanna SM (1989). Frontal lobe involvement in obsessive compulsive disorder. In: Bernard Lerer & Samuel Gershon (Eds.) *New Directions in Affective Disorder*. New York, Springer-Verlag, 432-434.
13. Khanna S, **Mukundan CR**, Channabasavanna SM (1989). Bereitschaftspotential in melancholic depression. *Biological Psychiatry*, 26: 526-529.
14. Joseph C, **Mukundan CR** (1989). Preliminary findings on skin conductance measures in schizophrenics and normal individuals in India. *Indian Journal of Medical Research*, 90: 88-90.
15. J Singh, **Mukundan CR**, Das BS, Arya BYT (1986). Contingent negative variations in patients with cortical lesions. *NIMHANS Journal*, 4, 23-32.
16. Michael A, Mirza KAH, **Mukundan CR** & Channabasavanna S.M. (1993). Interhemispheric electroencephalographic coherence as biological marker in alcoholism. *Acta Psychiatrica Scandinavia*, 87: 213-217.



17. Sudha S, Andrade C, **Mukundan CR**, Chandra JS (2003). Spectral EEG effects of electroconvulsive shock stimulus parameters: the development of a rationale for the optimization of the ECT stimulus. *Journal of ECT*, 19(4): 197-210.
18. Tripathi KK, **CR Mukundan** (2004). Differential processing of visual information from right and left central hemi fields during binocular viewing. *Ind J Aerospace Med* 48(2).
19. Tripathi KK, **CR Mukundan**, T Lazar Mathew (2003). Attentional modulation of heart rate variability (HRV) during execution of PC based cognitive tasks. *Ind J Aerospace Med* 47(1), 2003.
20. Vandana V, **Mukundan CR**, Nagaraja D (1996). Contingent Negative Variation in Dementia. *NIMHANS Journal*, 14 (2) 133-138.
21. John John, **Mukundan CR**, Khanna et al. (2007). EEG power spectra differentiate positive and negative subgroups in neuroleptic-naive schizophrenia patients. Paper submitted to *Journal of Neuropsychiatry and Clinical Neurosciences*.

**Reviewed publications on Neurocognitive Processes, from which the scientific basis of the Neuro Signature model was derived.**

1. Mukundan CR (1999). Power of Words: Neuro-cognitive Approach for Understanding Brain Mechanisms of Awareness. In: Sangeetha Menon, M.G.Narasimhan et al. *Scientific and Philosophical Studies on Consciousness*. National institute of Advanced Studies, Bangalore, India. 127-136.
2. Mukundan CR (1998). From perception to thinking – Verbal adaptation in human brain. In: Isaac JR and Purendu H (Eds) *Proceedings of International Conference on Cognitive Systems (1998)*, New Delhi, Allied Publishers, IX -XIII.
3. Mukundan CR (1997) On mind, memory and brain. *Indian Journal of Clinical Psychology*, Vol.24, No.2, 103-112.
4. Mukundan CR (1995) Central electrophysiological paradigms in Psychiatry. In Khanna S, Channabasavanna SM & Keshavan MS (Eds) *Mehtods in Biological Psychiatry Research*. In: *Psychiatry*. Tata-McGraw Hill, Bombay, 151-171.
5. Mukundan CR (1991) Cognition. In PN Tandon, B Bijalani & S Wadhva (Eds.) *Lectures in Neurobiology*, Wiley Eastern, New Delhi, 233-240.
6. Mukundan CR (1989) Schizophrenia: an attention deficit syndrome. In: MS Menon & V Nagaswami (Eds) *Biology of Schizophrenia: State of the Art*. *Proceedings of the SCARF*



- Symposium on New Vistas in Biological Understanding of Schizophrenia, Bombay. SCARF Publication, 26-42.
7. Mukundan CR (1989) Some psychophysiological and neuropsychological findings in abstinent alcoholics. In : RR Ray & RW Perkins (Eds) Proceedings of Indo-US symposium on Alcohol and Drug Abuse, Bangalore, NIMHANS Publication, 227-236.
  8. Mukundan CR, Narayana Reddy, GN, Hegde AS, Jayanthi Shankar & Kaliaperumal, V.G. (1987) Neuropsychological and clinical recovery in patients with head trauma. NIMHANS Journal, 5 (1):23-31.
  9. Mukundan CR, Rao SL, Jain VK, Jayakumar PN, Shilaja K (1991). Neuropsychological assessment: a cross validation study with neuroradiological /operative findings in patients with cerebral hemisphere lesions. Pharmacopsychologia, 4: 33-39.
  10. Annet C, **Mukundan CR** (1996) Social drinking - part I : Neuropsychological changes in social drinkers, NIMHANS Journal, 14 (1) 15-21.
  11. Dwivedi P, **Mukundan CR** (1993) Lateralization visual attention and distractibility. NIMHANS Journal, 11 (1): 27-34.
  12. Mohanti A, Das BS, **Mukundan CR**, Jamuna N (1993) Cognitive outcome and quality of life after Aneurysmal subarachnoid haemorrhage-Part I : Cognitive outcome. NIMHANS Journal 11,2: 107-117.
  13. Mohanti A, Das BS, **Mukundan CR**, Jamuna N (1993) Cognitive outcome and quality of life after Aneurysmal subarachnoid haemorrhage - Part I: Quality of life. NIMHANS Journal, 11,2 119-124.
  14. Nagaraj D, **Mukundan CR**, Shylaja (1989) Dementia in Parkinson's disease. Neurology India, 37,315-319.
  15. Nagraj D, Taly, AB, Herleker G, Rangamani GN, Shivashankar N, **Mukundan CR** (1989) Crossed aphasia in dextrals. Clinical Neurology & Neurosurgery, 91/92: 153-156.
  16. Rao SL, **Mukundan CR**, Jamuna N, Das BS, Sastri KVR, Hegde T, Reddy MV (1997) Pattern of association between symptoms and neuropsychological deficits in post traumatic syndrome. NIMHANS Journal, 15 (2).
  17. Thakur D, **Mukundan CR** (1988) Dichotic listening in schizophrenic and maniac psychotics. NIMHANS Journal 16, 6(2) 151-156.



## Books Published

1. Mukundan CR. (1986). Evoked Potentials – Basic Principles and Methods. NIMHANS, Publication, Bangalore. No.11.
2. Mukundan CR. (2007). Brain Experience – Neuroexperiential Perspectives of Brain-Mind. Atlantic Publishers & Distributors, New Delhi.
3. Mukundan CR, Vaya SL (2007). Foundations of Neuropsychology for Forensic Scientists (under publication).

## Invited papers published

1. Mukundan CR, Vaya SL (2004) Brain electrical activation fingerprinting, CBI Bulletin, 12 (10) 29 – 37.
2. Mukundan CR. (1998) Neuropsychological models of cognitive systems and execution - Tutorial. In : Proceedings of National Seminar on Artificial Neural Networks and Cognitive Systems, organized by Cochin University of Science & Technology, Cochin and Naval Physical and Oceanographic Laboratory, DRDO, Cochin, Cochin University, September 23 – 25.
3. Mukundan CR (1999). Psychological management of patients with dementia. In : Handbook for Caregivers of those suffering from dementia. A Banjara Academy Publication, Bangalore, India. 48-51.
4. Mukundan CR, Jyoti Ahuja & Radha Prabhu (1998) Neuropsychology. In: Vyas & Ahuja (eds) Postgraduate Textbook in Psychiatry. In Vyas JN, Ahuja N ( Eds) Textbook of Postgraduate Psychiatry, JP Brothers Medical Publishers, New Delhi, Vol 2, 691-708.
5. Mukundan, C.R. (2010). Reading from memory: a paradigm shift for deception detection in investigative psychology. Amity Journal of Applied Psychology. 1 (1), 24-34.\*\*



## Related Presentations

Sudha Suresh, **Mukundan C R** (1998). Age Influences on the Topography of the Event Related Potentials in a Word Recognition Task. In proceedings of the 9<sup>th</sup> World Congress of the International Organization of Psychophysiology, Taormina, Sicily, Italy.

Sudha Suresh, **Mukundan C R** (1998). Visual Information in Young, Middle and Elderly Subjects – An Event Related Potential Study. In proceedings of 9<sup>th</sup> World Congress of the International Organization of Psychophysiology, Taormina, Sicily, Italy.

Ramachandra S, **Mukundan CR**, Sharma MK, et al. (1990). Event related potential (ERP) and EEG power spectra in hypnosis. INT J PSYCHOPHYSIOL 30 (1-2): 251

Mukundan, C.R. (2005) Brain electrical oscillations signature profiling for forensic applications. Paper presented in the 17<sup>th</sup> Meeting of International Association of Forensic Sciences, Hongkong, August 21-26, 2005.

Invited presentation at Neurodynamics Laboratory, SUNY Downstate Medical Center, 450 Clarkson Avenue, Box 1203, Brooklyn, NY 11427, on May 15, 2007.

Invited presentation at Kirby at Kirby Forensic Psychiatric Center, New York, 100035, on May 11, 2007



## **Other Published Studies differentiating between “Knowing” and “Remembrance”, which support the scientific basis of the model used in Neuro Signature Profiling.**

Aggleton, J.P., Brown, M.W. (1999). Episodic memory, amnesia, and the hippocampal-anterior thalamic axis. *Behav Brain Sci.* 22: 425-44.

Allan, K., Wilding, E.L., Rugg, M.D. (1998). Electrophysiological evidence for dissociable processes contributing to recollection. *Acta Psychologica.* 98: 231–52.

Basar, E., Basar-Erogluc, C., Karaka, S., Schurmann, M. (2000). Brain oscillations in perception and memory. *International Journal of Psychophysiology.* 35: 95-24.

Basar, E., Basar-Erogluc, C., Karakas, S., Schurmann, M. (2001). Gamma, alpha, delta, and theta oscillations govern cognitive processes. *International Journal of Psychophysiology.* 39: 241-48.

Babiloni, C., Babiloni, F., Carducci, F., Cappa, S.F., Cincotti, F., Del Percio, C., Miniussi, C., Vito Moretti, D., Rossi, S., Sosta, K., & Rossini, P.M. (2004). Human cortical rhythms during visual delayed choice reaction time tasks. A high-resolution EEG study on normal aging. *Behav Brain Res.* 153, 261-71.

Babiloni, C., Vecchio, F., Cappa, S., Pasqualetti, P., Rossi, S., Miniussi, C., & Rossini, P.M. (2006). Functional frontoparietal connectivity during encoding and retrieval processes follows HERA model. A high-resolution study. *Brain Res Bull.* 68, 203-12.

Beck, D.M., Rees, G., Christopher, D., Frith, C.D., & Lavie, N. (2001). Neural correlates of change detection and change blindness. *Nature Neuroscience.* 4, 645 – 50.

Biederman, I. (1987). Recognition - by-components: A theory of human image understanding. *Psychological Review.* 94, 115-47.

Bressler, S.R. (1990). The gamma wave: a cortical information carrier? *Trends Neurosci.* 13, 161-62.

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Fiorio, M., Tinazzi, M., & Aglioti, S.M. (2006). Selective impairment of hand mental rotation in patients with focal hand dystonia. *Brain*, 129, 47-54.

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Graham, K.S., Lee, A.C., Brett, M., Patterson, K. (2003). The neural basis of autobiographical and semantic memory: new evidence from three PET studies. *Cogn Affect Behav Neurosci*, 3, 234-54.

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Kosslyn, S.M., Thompson, W.L., & Alpert, N.M. (1997). Neural systems shared by visual imagery and visual perception: a positron emission tomography study. *Neuroimage*. 6, 320-34.

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