Karthik H. Shankar

Research Scientist
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Research Profile:

I'm a theoretical physicst by training. I transitioned to work in theoretical cognitive neuroscience as a postdoctoral researcher. My research has been focused on constructing mathematical and network models of learning and memory over multiple timescales. My research interests include predictive algorithms and prediction error based learning algorithms. My overall research efforts are directed towards understanding the neural basis of human cognition and constructing optimal learning algorithms for intelligent systems mimicking human-like cognitive features.

Education:

- **Ph.D (Theoretical Physics) in 2007:** University of Florida, USA.
  Thesis : *Black Hole Evaporation*
- **Integrated MS. (Physics) in 2002:** Pondicherry University, India.
  Thesis : *Quantum Information Theory/Quantum Computing*

Employment history :

- July 2011 – present, Research Scientist, Center for Memory and Brain, Boston University, USA.
- 2007 - 2011, Post Doctoral Researcher, Department of Psychology, Syracuse University, USA.
- August 2002- May 2007, Teaching/Research Assistant, Department of physics, University of Florida, USA.

Patents (pending):

K. H. Shankar, Z. Tiganj and M. W. Howard. A method for constructing a scale-invariant memory buffer. US Patent Application : 14846804.

Publications in Cognitive Science, Neuroscience, Machine Learning :

- K. H. Shankar and M. W. Howard (2016). Neural Mechanism to simulate a scale-invariant future timeline. *Neural Computation, in press*. arXiv:1503.03322
- M. W. Howard and K. H. Shankar (2016). Neural scaling laws for an uncertain world. arXiv:1607.04886.
- K. H. Shankar and M. W. Howard (2015). Scale-Free Memory to swiftly generate fuzzy future predictions. *Proceedings of the Fifth International Conference on Fuzzy and Neuro Computing (FANCCO-2015),* 185-194.
- K. H. Shankar (2015). Generic construction of scale-invariantly coarse grained memory, *Lecture Notes in Artificial Intelligence,* **8955,** 175-184. arxiv/1406.3185.
- M. W. Howard, K. H. Shankar, W. R. Aue and A. H. Criss (2014). A quantitative model of internal time in memory, *Psychological Review,* **122**, 24-53.
- K. H. Shankar (2014). Quantum Random Walks and Decision making, *Topics in Cognitive Science*, **5** (4), 35-42.
- M. W. Howard, C. MacDonald, Z. Tiganj, K. H. Shankar, M. Hasselmo, H. Eichenbaum (2014). A unified mathematical framework for coding time, space, and sequences in the hippocampal region, *Journal of Neuroscience*, **34**, 4692-4707.
- B. K. Martens, L. E. Gertz and K. H. Shankar (2014). Measures of Association in Contingency Space Analysis. *Journal of Mathematical Psychology,* **59**, 114.
- K. H. Shankar and M. W. Howard (2013). Optimally fuzzy temporal memory, *Journal of Machine Learning Research*, **14**, 3785-3812. arxiv:cs-ai/1211.5189.
- M. W. Howard, I. Viskontas, K. H. Shankar and I. Fried (2012). Ensembles of human MTL neurons jump back in time in response to a repeated stimulus. *Hippocampus*, **22**(9), 1833-1847.
- K. H. Shankar and M. W. Howard (2012). A scale invariant internal representation of time, *Neural Computation,* **24**, 134-193.
- M. W. Howard, K. H. Shankar and U. K. Jagadishan (2011). Constructing semantic representations from a gradually-changing representation of temporal context, *Topics in Cognitive Science*, **3**, 48-73.
- K. H. Shankar and M. W. Howard (2010). Timing using temporal context, *Brain Research,* **1365**, 3-17.
- K. H. Shankar, U. K. Jagadishan and M. W. Howard (2009). Sequential Learning using temporal context, *Journal of Mathematical Psychology*, **53**, 474-485.

Publications in Theoretical Astrophysics:

- K. H. Shankar (2016). Horizonless, singularity-free compact shells satisfying NEC. *Gen. Relativity and Gravitation, in press.* arXiv:1510.00851
- K. H. Shankar and A. Balaraman and K. C. Wali (2012). Metric theory of gravity with torsion in an extra dimension, *Phys. Rev.* **D 86** (2), 024007, arxiv: gr-qc/1203.5552.
- K. H. Shankar and K. C. Wali (2010). Kaluza-Klein Theory with Torsion confined to the extra-dimension, *Mod. Phys. Lett.* **A 25** (25), 2121-2130**,** arxiv: gr-qc/0904.4038.
- K. H. Shankar (2007). Black hole Evaporation : Validity of Quasi-static approximation. *Ph.d. thesis,* http://ufdc.ufl.edu/UFE0019811/00001.
- K. H. Shankar and B. F. Whiting (2007). Conformal coordinates for a constant density star, arxiv. gr-qc/0706.4324.
- L. R. Price, K.H. Shankar and B. F. Whiting (2007). On the Existence of Radiation Gauges in Petrov type II spacetimes. *Class. Quant. Grav* **24** (9), 2367.
- K. H. Shankar and B. F. Whiting (2007). Self force of a static electric charge near a Schwarzschild Star, *Phys. Rev.* **D 76** (12), 124027, arxiv: gr-qc/0707.0042.

Awards:

Outstanding International Student Award (College of Liberal Arts and Sciences, University of Florida , 2006- 2007).

Computer Programing Experience:

- Programming languages: C, C++, R, Python.
- Mathematical Application softwares: Maple, Mathematica, Matlab.
- Numerical evolution of Nonlinear Differential equations.

Teaching Experience:

Teaching undergraduate physics lectures, discussions, and labs at University of Florida, USA. August 2001-April-2007.

Courses taught : Mechanics, Electro-Magnetism and Thermodynamics.

Review service:

Topics in Cognitive Science, Journal of Mathematical Psychology, Synesthese, Journal of Memory and Language**,** Psychonomic Bulletin & Review**,** Cognitive Science, Poland NCN (National center for Science).

Selected Workshops attended:

- Advanced Studies Institute on Thermalization (ASIT) : From Glasses to Black Holes, International Center for Theoretical Sciences (ICTS), Bangalore, India, June 2013.
- Physics of Behavior, Aspen Center for Physics, Aspen, Colorado, June 2012.
- Advanced Course in Computational Neuroscience (ACCN), Bernstein Center, Frieburg, Germany, August 2008.

Selected Conference presentations and Invited talks

- Poster at Computational and Systems Neuroscience (COSYNE), Salt Lake City, Utah, March 2016.
- Talk at International conference on Fuzzy and Neuro Computing (FANCCO), Hyderabad, India, Dec 2015.
- Talk at APS-March meeting, San Antonio, Texas, March 2015.
- Talk at Artificial Life and Computational Intelligence (ACALCI), University of NewCastle, Australia, Feb 2015.
- Talk at Context and Episodic Memory Symposium (CEMS), University of Pennsylvania, Philadelphia, May 2013.
- Poster at Computational and Systems Neuroscience (COSYNE), Salt Lake City, Utah, March 2013.
- Invited talk at Syracuse University (Physics Dept.), Oct 2012
- Talk at the workshop Physics of Behavior, Aspen Center for Physics, Aspen, Colorado, June 2012.
- Invited talk at Raman Research Institute, Bangalore, India, Nov 2011.
- Invited talk at TIFR-Center for Applied Math, Bangalore, India, Nov 2011.
- Invited talk at Center for Neuroscience, IISC, Bangalore, India, Nov 2011.
- Invited talk at Institute of Mathematical Sciences, Chennai, India, Nov 2011.
- Talk at Society for Mathematical Psychology (SMP). Boston, Massachusetts, July 2011.
- Poster at Computational and Systems Neuroscience (COSYNE), Salt Lake City, Utah, Feb 2011.
- Talk at Society for Mathematical Psychology (SMP), Portland, August 2010.
- Poster at Context and Episodic memory Symposium (CEMS), University of Pennsylvania, Philadelphia, May 2010.
- Talk at Society for Mathematical Psychology (SMP), Amsterdam, Netherlands,

August 2009.

- Talk at Computational Cognitive Neuroscience Conference (CCNC), Boston, November 2009.
- Poster at International Conference of Cognitive and Neural Systems (ICCNS), Boston, May 2009.