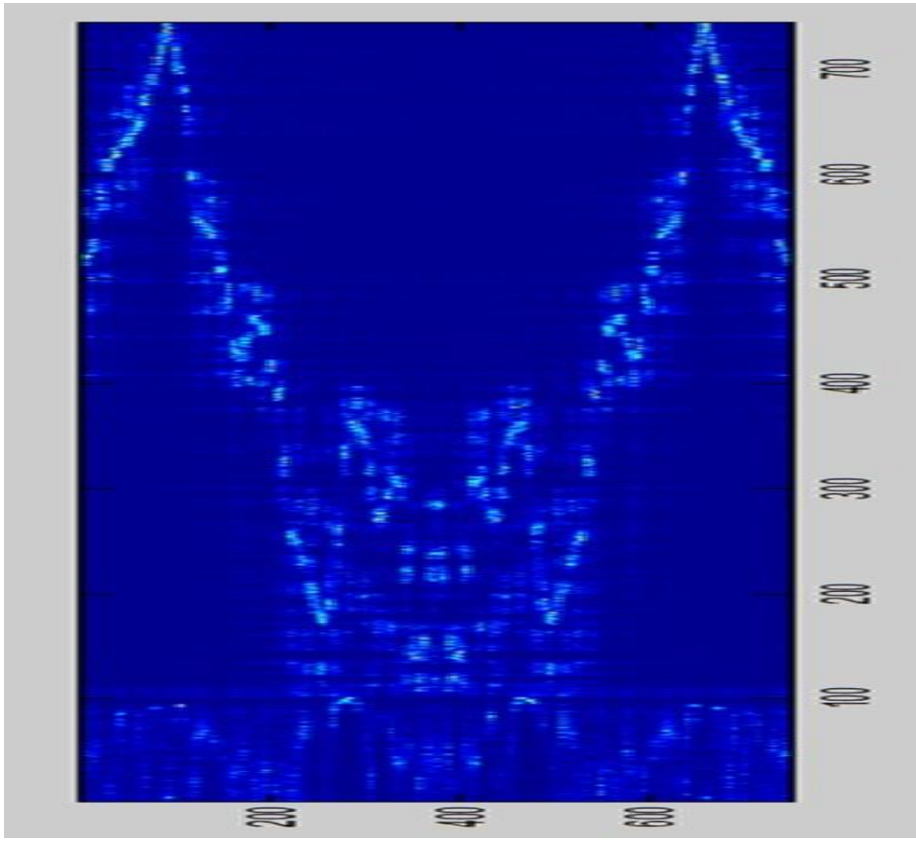
The Evolution of Multi-Channel Blind Deconvolution using a MATRIX.

1. Convolution, from a Statistical point of view,
involves integrals of a pair of a probability functions,
where one is formed as a difference, with additional
constraints of infinite limits of integration.
Or
Convolution, from a Physics point of view,
involves integrals of a pair of a physical functions,
where one is reversed, and hence, physically opposes
the other, in time, with the infinite limits of integration.
Or
Convolution, from an Engineering point of view,
may involve summations of a pair of a discrete
system functions, where one sequence is reversed
to act as a filter through which the other function
must pass through. Limits may be finite or infinite.
Or
2. Convolution, from a practical point of view,
Is nothing more than polynomial multiplication
which is taught in High School. It is finite. It ends.
Now, (*someone*) placed this multiplication in the context
of a single matrix. Then,
Then, Eike Rietsch, a Geophysicist, implemented a
Multi-Channel Matrix version to handle Passive Seismic
Arrays in order to cross correlate the Signals. *Nice!*
The interesting part is that the matrix separates a common
Signal across the array, but then places the remainder,
The 'good diversity' part, into the so-called Null-Space.
Also interesting, is the fact that in Mathematics, this
Nullspace has been referred to as 'Sick'. *Not-so-nice!*
Note: Essentially, we are finding roots of the polynomials.



A Louisiana Crawfish with nullspace for a tail

3. Much attention was given to reducing the Nullspace in order to obtain the system diversity. Data Plasticity, instead, chose to characterize and then reorganize the Null-space, *before reduction*, to exploit subtle numerics. Nature makes it difficult, but not impossible, to implement. Interestingly, it works very well with Binary Error Codes.

Thanks go to UNO, NRL Stennis, National Academies, AFRL, and, Sean, Adam, Edmond, Andy, Alfredo, and Noga.

The evolution of the hybridization of Hierarchical and Bi-directional Neural Networks into the ***Joint Proximity Association Template***

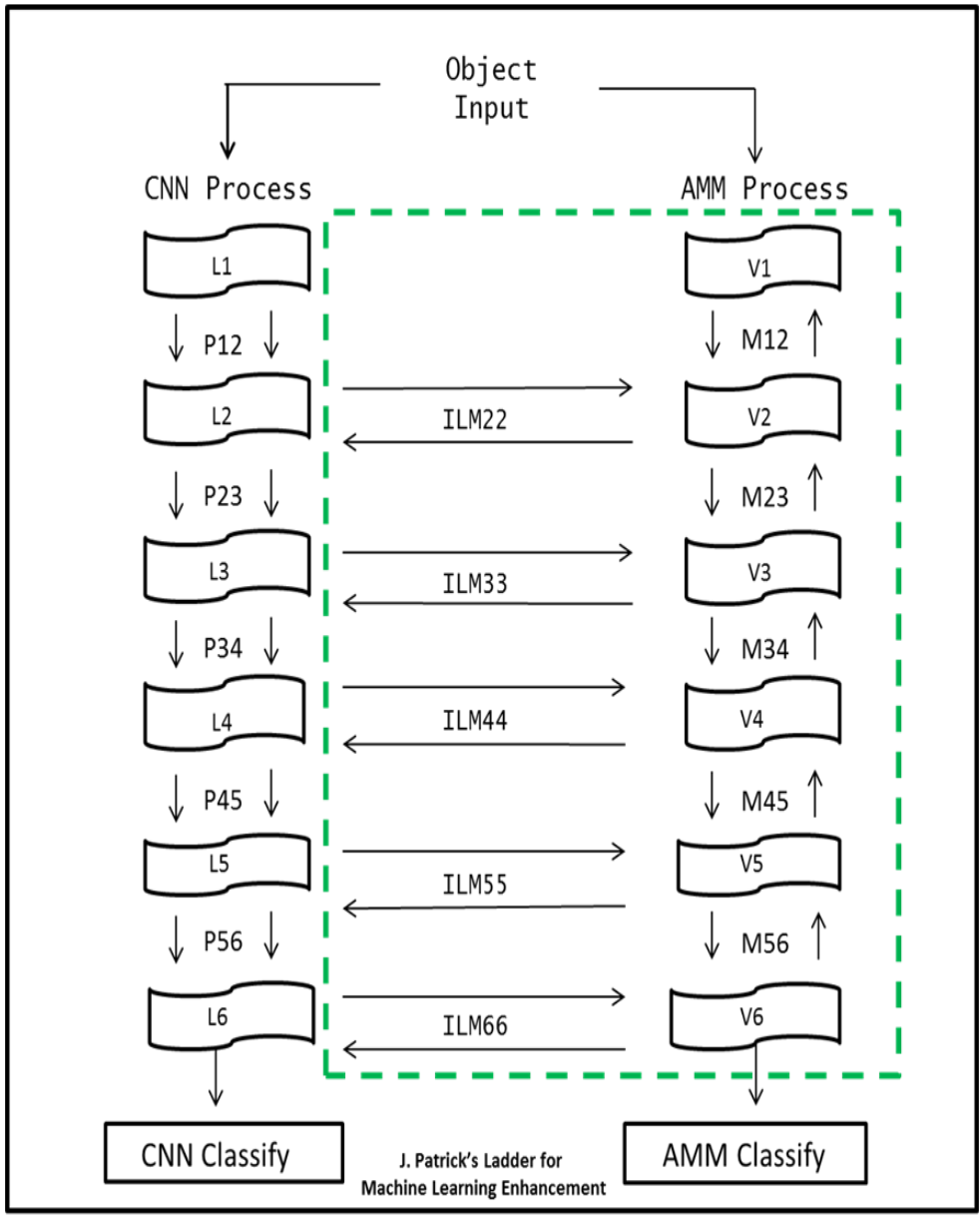
*James P. LaRue, **www.DataPlasticity.com***

1. The original multi-layer Neural Network was about Modeling how the Brain thinks. LeCun's extension, the Convolutional NN, was about adding sensor intake transformations at the front end. *Nice!* The downside to CNN is that it can only think in one direction, and it's complicated.

2. Kosko and Grossberg wanted to, first and foremost, build a device that was bi-directional, and, make it less complicated. The result is known as Bidirectional Associative Memory (BAM). *Nice!* The problem was finding a stable threshold about which the association was made.

3. JPAT starts with the CNN up front. Then, a stabilized, (non-threshold) version of BAM reduces the complicated CNN stages into smaller, bidirectional units. *Lucky!*

4. The thing in green, ***JPAT***, yields 10x reduction in training, 30x reduction in time to classify, and Is not just bi-directional, but quadri-directional. Thus, JPAT can connect and cross integrate parallel Systems of nueral networks, and, meet the criteria of the ***Universal Approximation Theorem.***



The evolution of connecting Speech Processing and how the difference in one single bit, can dis-entangle biological signaling in Nature and binary signaling in Computer, to form the ***Audio Visual Intelligence Protocol Evaluator - AVIPE***

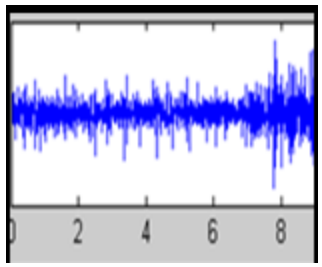
The point here is, that with an intelligent communication, there is an intelligence protocol.
1. An old guy from Avondale Shipyards, Randall King, Introduced me to the concept of the Boundary Conditions and STANDING WAVE in RADAR.

2. An old guy from AFRL Audio Dept., Jim Cupples, introduced me to the concept of guttural response measurement using CEPSTRUM in human SPEECH.

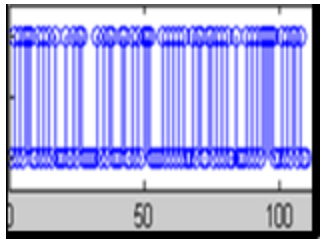
3. Thus, combining the two concepts, is the key to properly re-framing the signal of interest, be it Natural or Artificial, where the higher altitude point of view will reveal the pockets of underlying and intelligent communication subtle to outside, but understood within, the system itself.

AVIPE does not listen to or look at the original signal, instead, it exploits the system's underlying time-varying evolution of the system intelligence protocol on which the original Signal is carried.

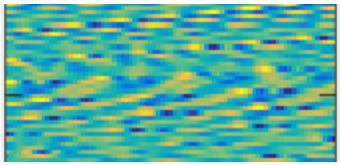
Beyond speech, it has been successfully applied to Computer network in-house traffic, the EKG, and, the Mosquito, the vibration of an Air Conditioner,….

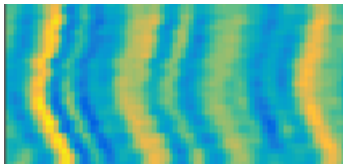


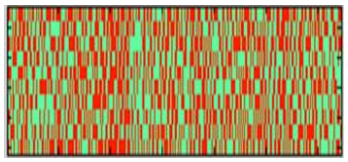
Analog signal reframed
(A) Incorrectly by 176 and
(B) Correctly by 177

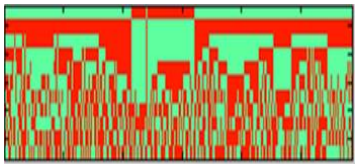


Binary signal reframed
(A) Incorrectly by 10 bits and
(B) Correctly by 11 bits

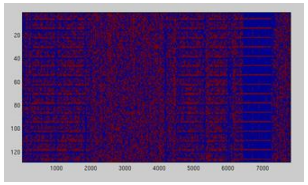








From Web-Page To Cepstral Equivalent

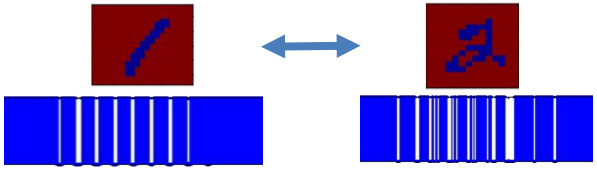


Optimizing Neural Networks with *STABILIZED* Bidirectional Associative Memory

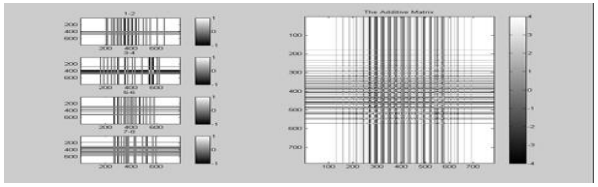
Principles in Independent Component Analysis and Null Space (PICANS)

We stabilized the Bidirectional Associative Memory (BAM) algorithm utilizing the singular value decomposition (SVD), Independent Component Analysis (ICA), and Nullspace (NS). Demonstrated with two applications: (1) Utilizing a simple ***one-layer association*** used for text ID given by Bart Kosko (1982), and (2) utilizing ***multiple layers of associations*** in a convolutional neural network modeling the ventral pathways used for computer vision. Work performed September 2011-November 2012.

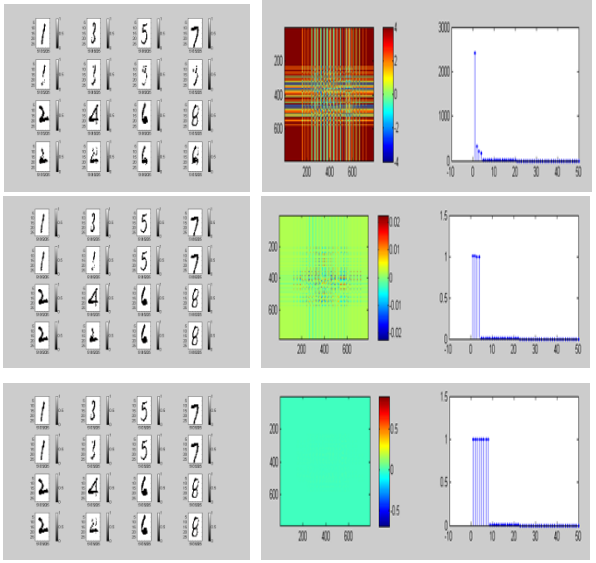
Example(1) Text Association



$$M = X_1 \times X_2^T + X_3 \times X_4^T + X_5 \times X_6^T + X_7 \times X_8^T$$



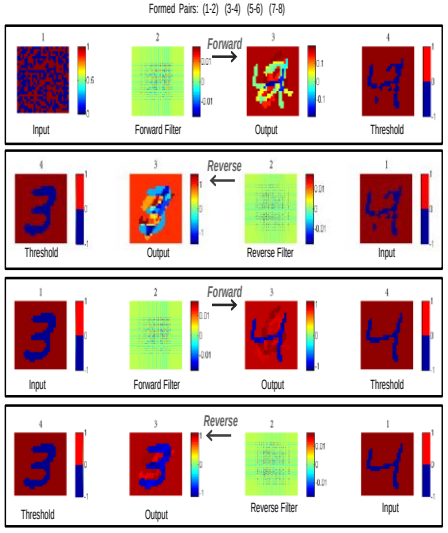
$$\sum_{i=1}^{4} U_i S_i V_i^T \approx M$$



PM: Yuriy Luzanov
AFRL RIGC

TPOC: James P. LaRue, PhD
james@JadcoSignals.com
www.DataPlasticity.com

Bidirectional Associative Memory

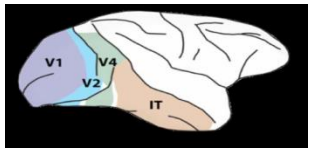


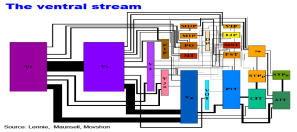
Sponsored by:

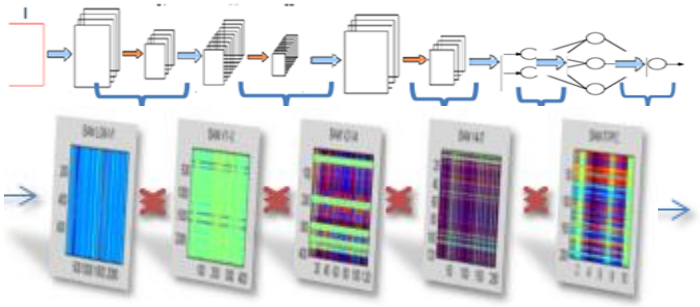
AFOSR Cognition and Decision Program
PM-Dr. Jay Myung

DARPA Innovation House
PM- Mr. Mike Geertsen

Example(2) CNN and BAM in Forward Mode







Single CNN Layer

Image IN	1936 points
1. 12 KV1 Filters	
2. 2D Convolution	
3. Tanh compress	
4. Down sample by 4	
5. Multiply by weights	
6. Add biases	
7. Tanh compress	
V1 OUT	5808 points

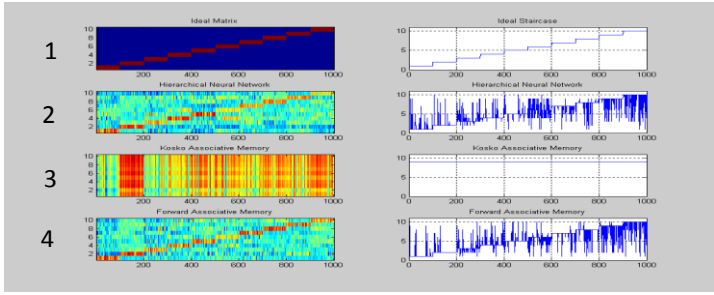
0.0855 Seconds/Five layers

Associative Memory

Image IN	1936 points
1. FAM LGN-V1	1936x5808
V1 OUT	5808 points

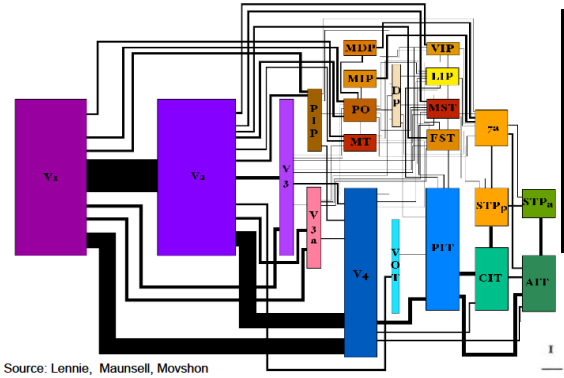
0.0031 Seconds/Five Layers

Test: (1) Ideal (2) CNN (3) BAM Unstable (4) BAM Stable



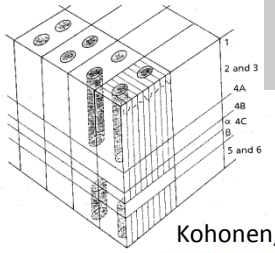
Hubel &Wiesel, Rosenblatt, Fukushima, Poggio

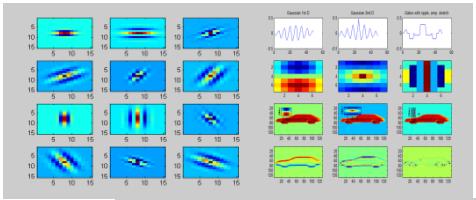
The ventral stream



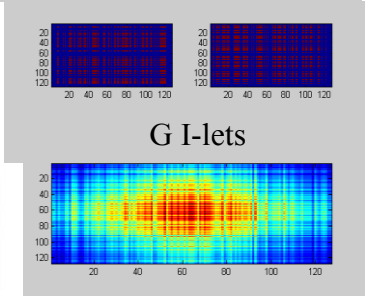
Source: Lennie, Maunsell, Movshon

Jeff Hawkins
Hierarchical Temporal Model

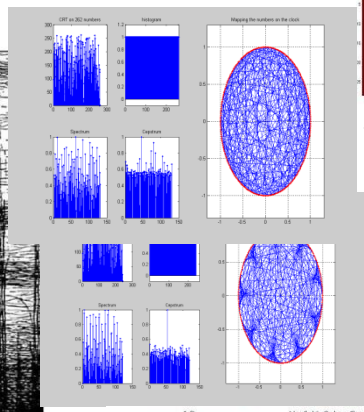


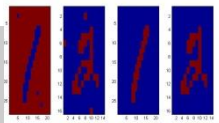


Kohonen, Kosko,

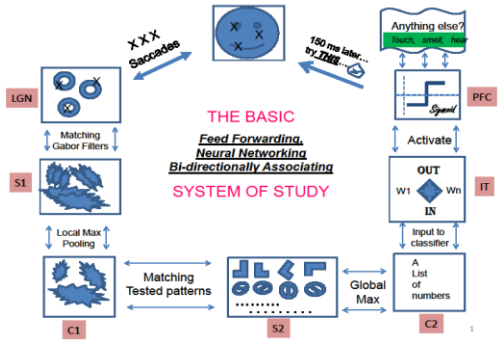


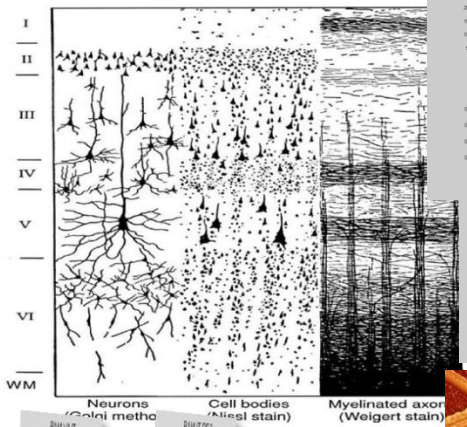
Cohen-Grossberg, Hopfield

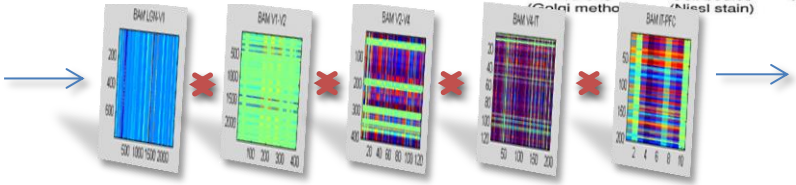


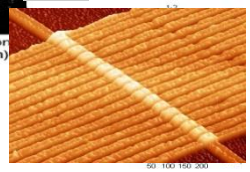


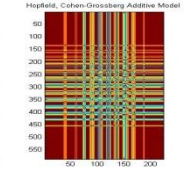
Widrow, and Adeline, Werbos and back-propagation
deltaw{l} = alpha * deltaw{l} - mu*delta{l} * (Y{l})';

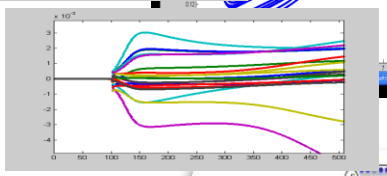




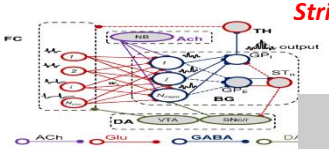




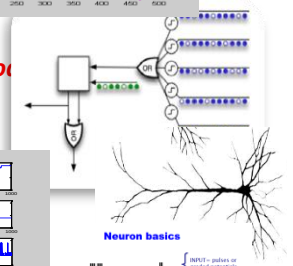


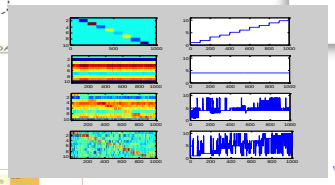


Leon Chua, Memristors



Striatal Beat-Frequency o
Meck, Buhusi,





Louis Narens, Support Theory Based on a Non-Boolean Event Space, *need not satisfy the principles of the Law Of The Excluded Middle and the Law of Double Complementation.*
Graciela Chichilnisky extend the foundation of statistics to integrate rare events that are potentially catastrophic, called ***Black Swans***.

Richard Tutwiler, Kenric Nelson, Edmond Rusjan, Scott Martinez, Adam Bojanczyk, Randall King, Mark Pugh, Andrew Noga, Ron Chapman, Bill Copeland, Angel Estrella – University of Yucatan, Alfredo Vega, Lauren Huie, Hugh Williamson, Andy Williams, Yuriy Luzanov, Jay Myung, Mike Geertsen
James P. LaRue *dba JadcoSignals* – Combined their ideas to form BAM, Philosophically speaking

Aurel A. Lazar
Neuromorphic model of spike processing

AFRL/AFOSR Cognition and Decision Program 2010-2012

DARPA Innovation House Sept-Nov 2012

Jadco Signals 2011-

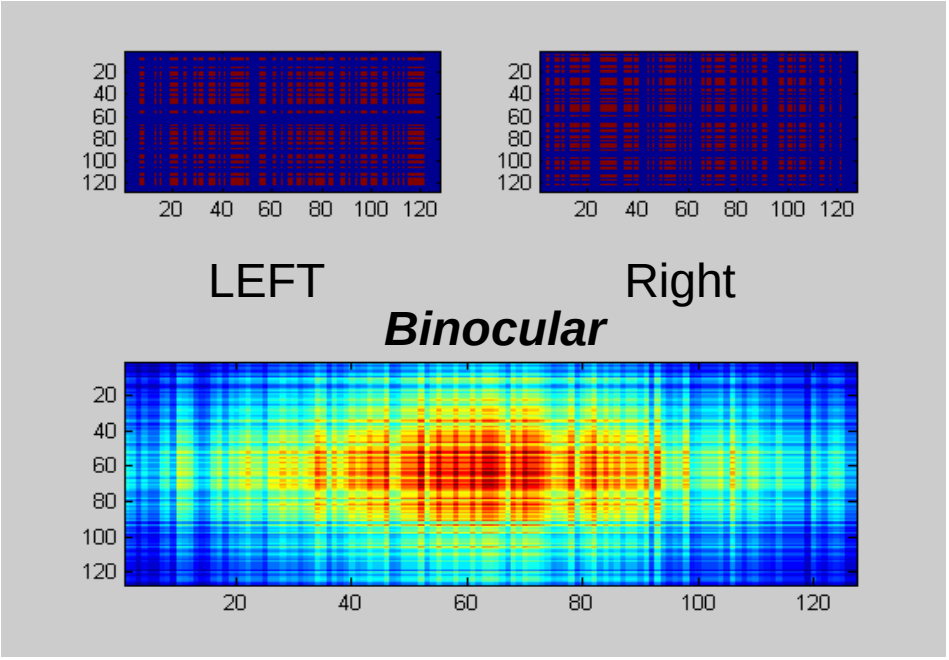
twentyoneseconds

www.DataPlasticity.com

Lagniappe

(Gabor) I-Lets formed through convolution of special sequences

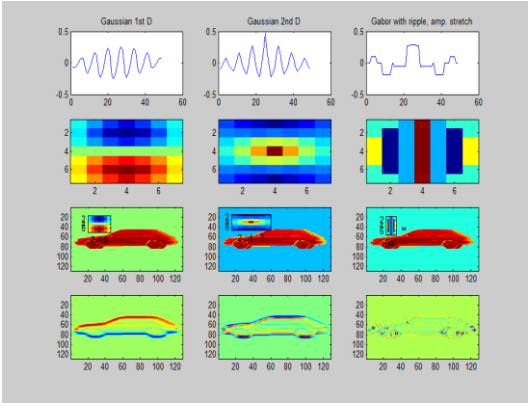
Note: Convolution and Correlation are only equivalent when the functions are symmetric, like in the case of a Sinc or Gabor function

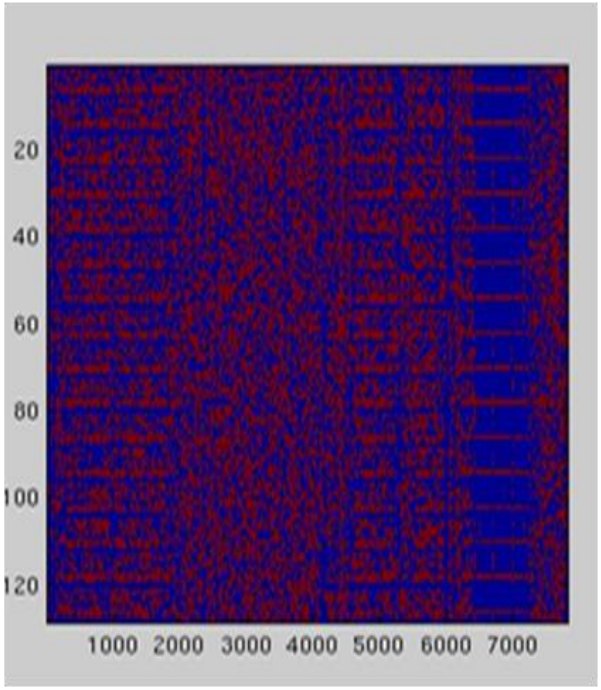


$$Convolution\big(f(x,y),g(x,y)\big) = \sum_{j=-N}^{N} f(i,j)g(x-i,y-j)$$

$$Correlation\big(f(x,y),g(x,y)\big) = \sum_{j=-N}^{N} f(i,j)g(x+i,y+j)$$

Mixture of Fourier and Special Sequences possible design improvement over Cat and Slit experiment. Process will track movements of reverse, rotate, translate, and dilate…and is well defined.
Inspired by paper on hierarchical peripheral vision.

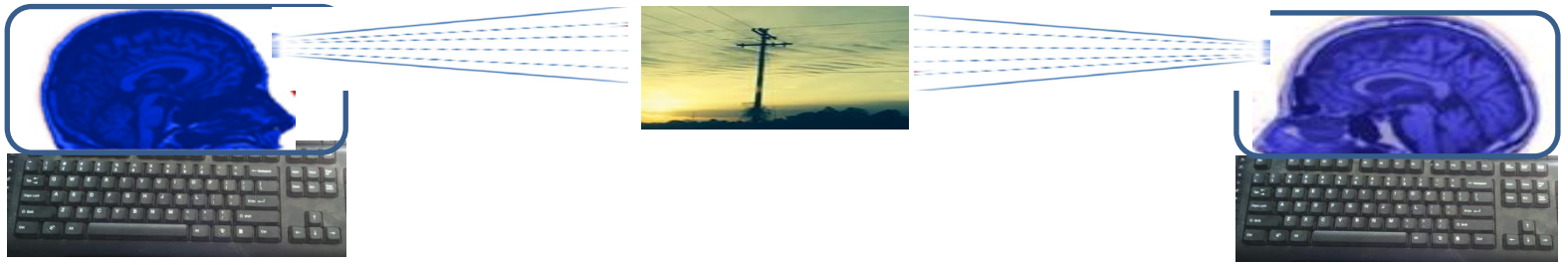



20
40
60
80
100
120
1000 2000 3000 4000 5000 6000 7000

Kristanna Loken in Terminator 3 – Rise of the Machines

Early on, she dials up a Data Warehouse for information on her target John Connor.

The next thing you hear is their speaking ‘fax’ over the phone …,



BIG DATA
Perception Center

Streaming traffic
Audio/Visual