EXPLOITING HUMAN-MACHINE (HM) COLLABORATION TO ACHIEVE SUPERIOR SOURCE SEPARATION AND COMPREHENSION (SS&C) SYSTEMS

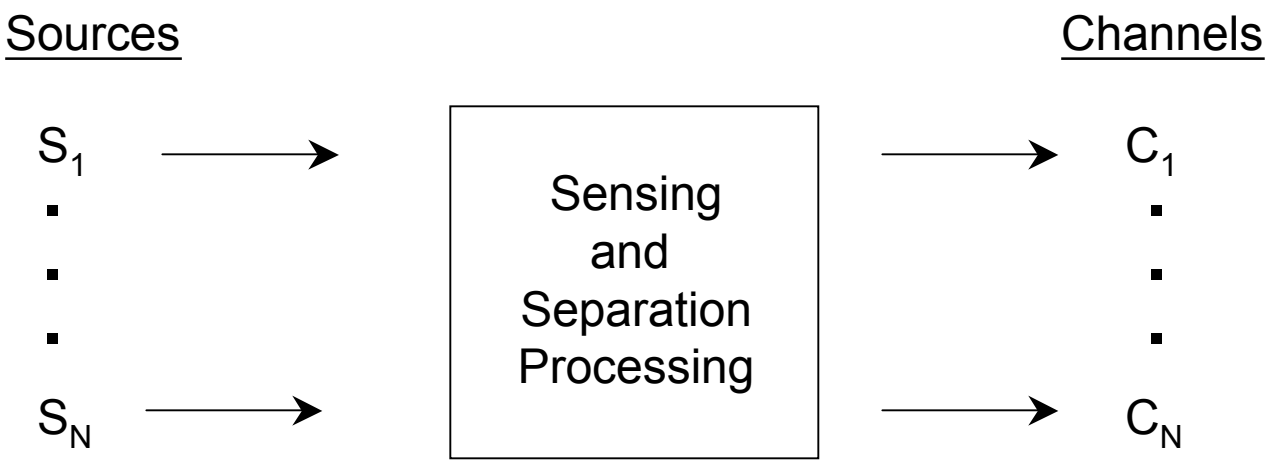
Potential ways in which humans can contribute to the improvement of SS&C systems:

- Apply general engineering capabilities and resources to develop effective SS&C machines
- Acquire scientific knowledge about human SS&C processing to serve as an inspiration for machine design
- **Serve as components in collaborative HM systems**

OUTLINE OF THIS PRESENTATION

- Definition of Source Separation
- Relation of Separation to Comprehension
- Humans vs Machines
- Overview of Session on HM SS&C Systems

DEFINITION OF SOURCE SEPARATION



N Sources are separated $\equiv$

For every partition of the set of N sources into disjoint subsets N_1 and N_2, turning off all sources in subset N_1has no affect on any of the signals in the channels representing subset N_2

RELATION OF SEPARATION TO COMPREHENSION

Comprehension is severely impeded by a low degree of separation;

However, separation does not necessarily help comprehension because separation processing may distort signals in a manner that degrades comprehension

[Analogy to improving S/N ratio for speech in noise without improving intelligibility]

There exist cases in which comprehension is used to aid separation processing.

DIVERSITY OF APPLICATION DOMAINS

Telephone Line	*Worst Case* Single-Channel SS&C
Microphones at Sample Points in Space	*Intermediate Case* Multi-channel SS&C
Microphone at Each Source	*Best Case* Preservation of Separation in Simultaneous Presentation to Humans

HUMANS VS MACHINES

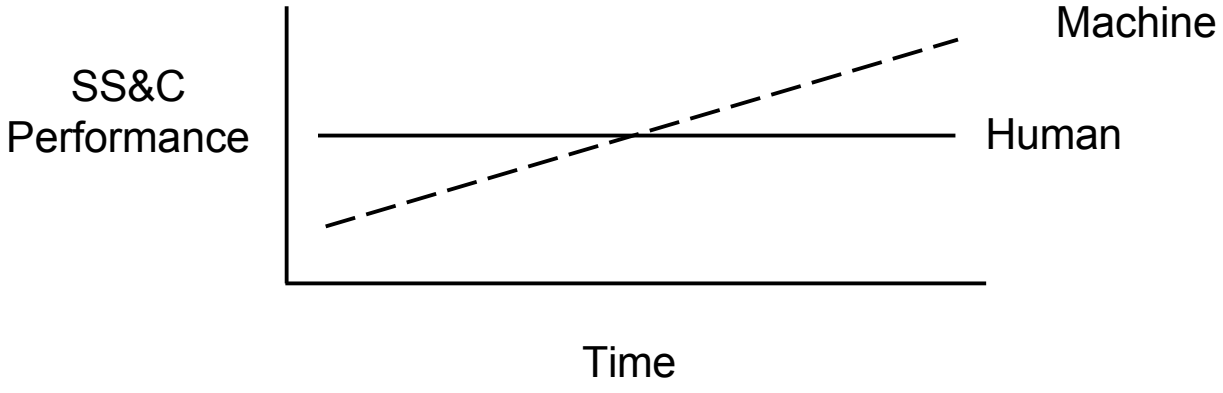
Humans tend to regard human SS&C as very good for two reasons:

(1) They are us
(2) Flawed thinking about evolution

However, human SS&C is relatively poor in a variety of ways:

(1) Poor sensing array
(2) Poor storage and retrieval
(3) Poor attentional control

Main virtue of humans relative to machines for SS&C is that humans have more experience



OVERVIEW OF HM SS&C SESSION

- Interfacing with the Machine

  Dr. Sumit Basu, *Post-doctoral Researcher, Microsoft Research, Redmond, WA*

  Dr. Jay Desloge*, Research Scientist, Sensimetrics Corp., Cambridge, MA*

- The Augmented Cognition Program: Attentional Control

  Professor Misha Pavel*, Computer Science, Biomedical Engineering, OGI School of Science and Engineering*
  Oregon Health and Science University

- Adaptation and Perceptual Learning

  Professor Betty Tuller*, Complex Systems and Brain Sciences, Florida Atlantic University*

- Post-Separation Magnification of Speech Stream Differences

  Voice Differences

  Professor Abeer Alwan*, Electrical Engineering, University of California in Los Angeles*

  Spatial Differences

  Professor Barbara Shinn-Cunningham*, Cognitive and Neural Systems, Biomedical Engineering*
  Boston University