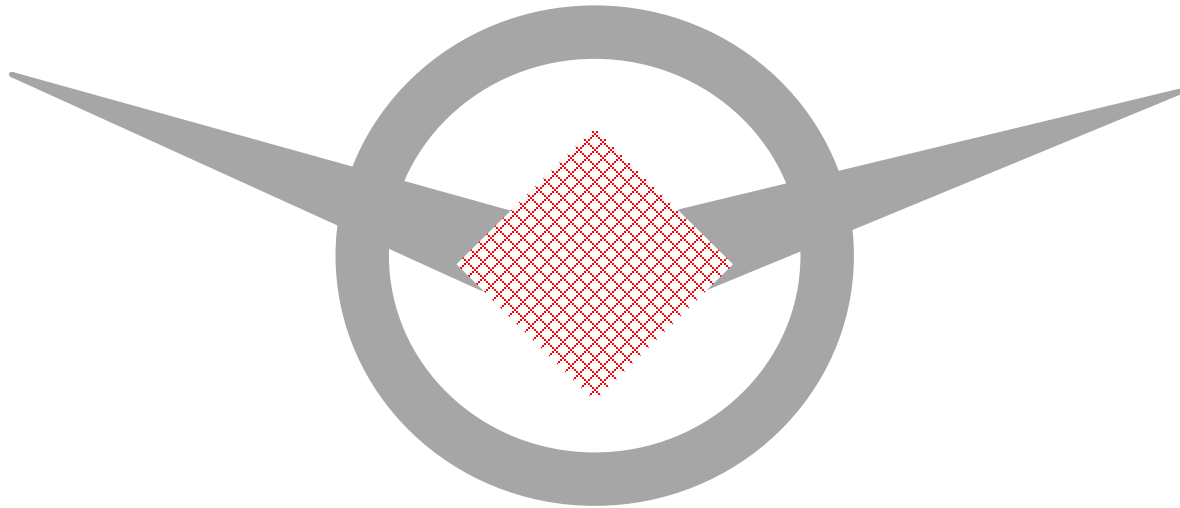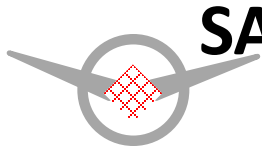# SOUTHERNAIRAVIATION

"FLY-BY-VOICE™ INTO NEXTGEN CENTURY"
Voice Activated Cockpit Management Systems

Diane Serban, Ph.D., SAA Inc.
Vincent Houston, NASA Langley Research Center

# SAA Provides Off-Line VOICE RECOGNITION Solutions to Redistribute Cockpit Workload

Problem

"Over the past 10 years, **45%** of business jet accidents have occurred during **landing**. Since 2012 this accident rate has increased dramatically to **58%**." (Breiling)

Solution

NextGen voice activated cockpit technologies improve efficiency and minimize human factors contribution to critical decision making.
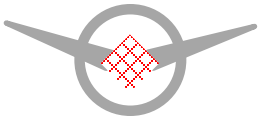
FLY-BY-VOICE

Aviation, Air Transport, and Airports:
FLY-BY-VOICE™ Platforms provide airframe and avionics manufacturers of commercial and military aircraft a variety of cockpit voice systems for use by pilots during flight operations. Developers of pilot and air traffic controller training and simulation systems use FLY-BY-VOICE™ platforms for training and certification testing of personnel.

Human-Centered Field Automation:
FLY-BY-VOICE™ Platforms provide equipment inspectors, mechanics, pilots, and examiners, with interactive transfer of control authority during operational procedures.

Defense & Public Safety:
FLY-BY-VOICE™ Platforms provide military personnel with noise-robust embedded voice solutions for military applications like command and control in mission flight environments.

MedEvac:
FLY-BY-VOICE™ Platforms provide MedEvac personnel with instant alert response and interactive solutions in a variety of applications, from doctors' reports to entry of data for patient medical records, and semi-automation of emergency protocols.
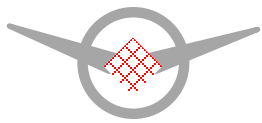
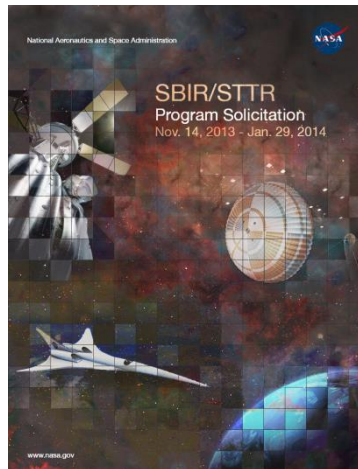# SAA Technology Meets The Highest Standards

FLY-BY-VOICE™ INTO NEXTGEN CENTURY

National Competition Award for Best Technology

Phase I (2012)
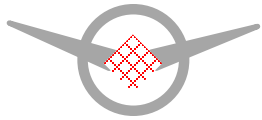(top 10% of 220 awards out of 11,000 applications)

Phase II (2014)
(top 10% of 98 Phase II awards progressing forward out of the 220 Phase I awarded,
The only accelerated Phase II award out of 98)

Phase III (2015)
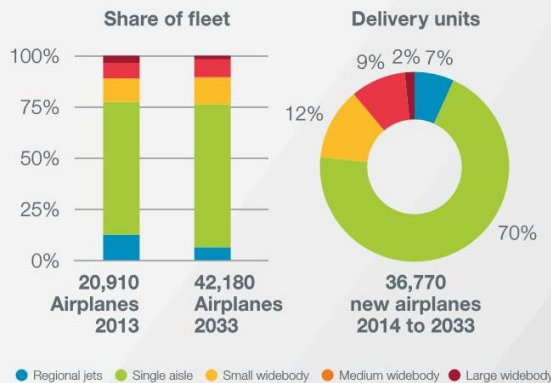Commercial Entry

Commercial Applications Developments

Aircraft Manufacturer

Avionics Manufacturer

All Commercial, Industrial, Display, Protocol, and Nav. Cockpit Functions have been Voice Enabled using SAA's proprietary VOICE-ARINC Architecture
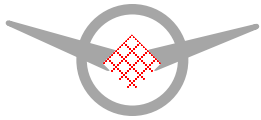
High Accuracy in High Noise High Stress Environment

CURRENT 75%

NEXTGEN 97%
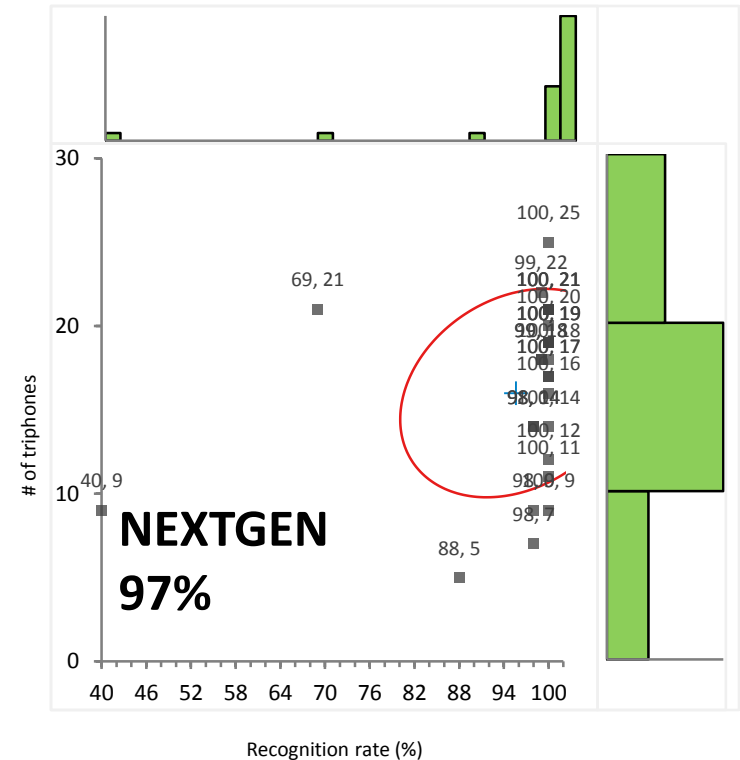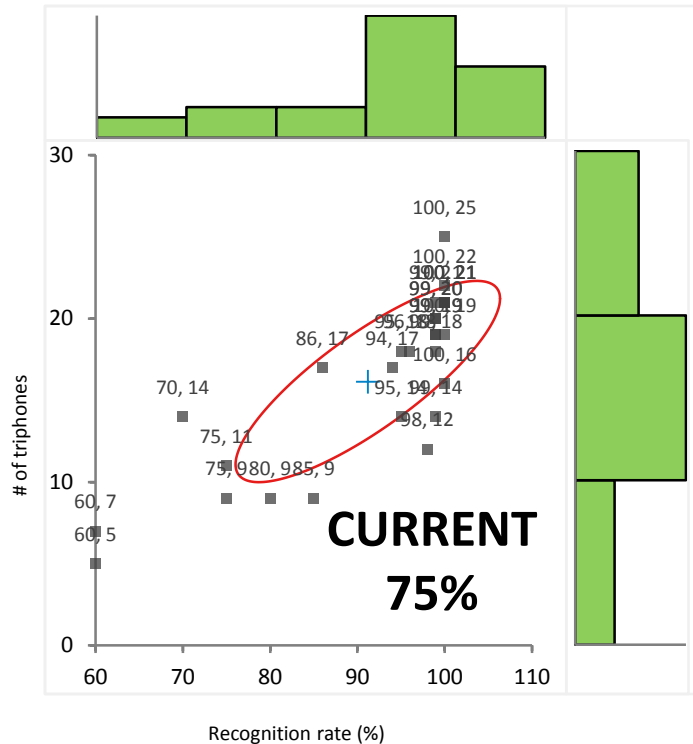
- The VOICE recognition has been rendered speaker-independent

- The system achieves a "continuous utterance" recognition rate of 96-98% regardless of the number of tri-phones in an utterance

- The recognition system allows the chaining of 36 command words in an single utterance and a correction of a misspoken command in the same utterance with 98% accuracy
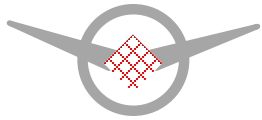
System Properties

- Off-Line Voice Recognition Solution (Non-Cloud Based)

- Flexible/Continuous Speech Recognition

- No Accent Bias

- Cockpit Grammar

- Cockpit Vocabulary

- Phonetic Distance Recognition

- Perplexity Recognition

- No Training Required

FLY-BY-VOICE Technology abetted by a heuristic method, achieves command accuracy of more than **96% in the cockpit during flight**

FLY-BY-VOICE has been tested in Cirrus, Diamond, Beechcraft, Cessna Citation, Airbus, and Boeing B747 environments, at noise levels of up to 136dB and various configurations (run-up, climb, cruise, descent, high and low altitude), for a total of 750 flight hours to date
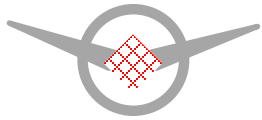
Cockpit Procedures Voice Management System

- **Automated** Emergency and Standard (Flight) Procedures/Protocols
- **Self-Sustaining** Cockpit Interface for (Aircraft) Systems
- **Actuation, Monitoring and Control** of Cockpit Instruments and Systems
- Heuristic Challenge Response for **Advanced Safety**
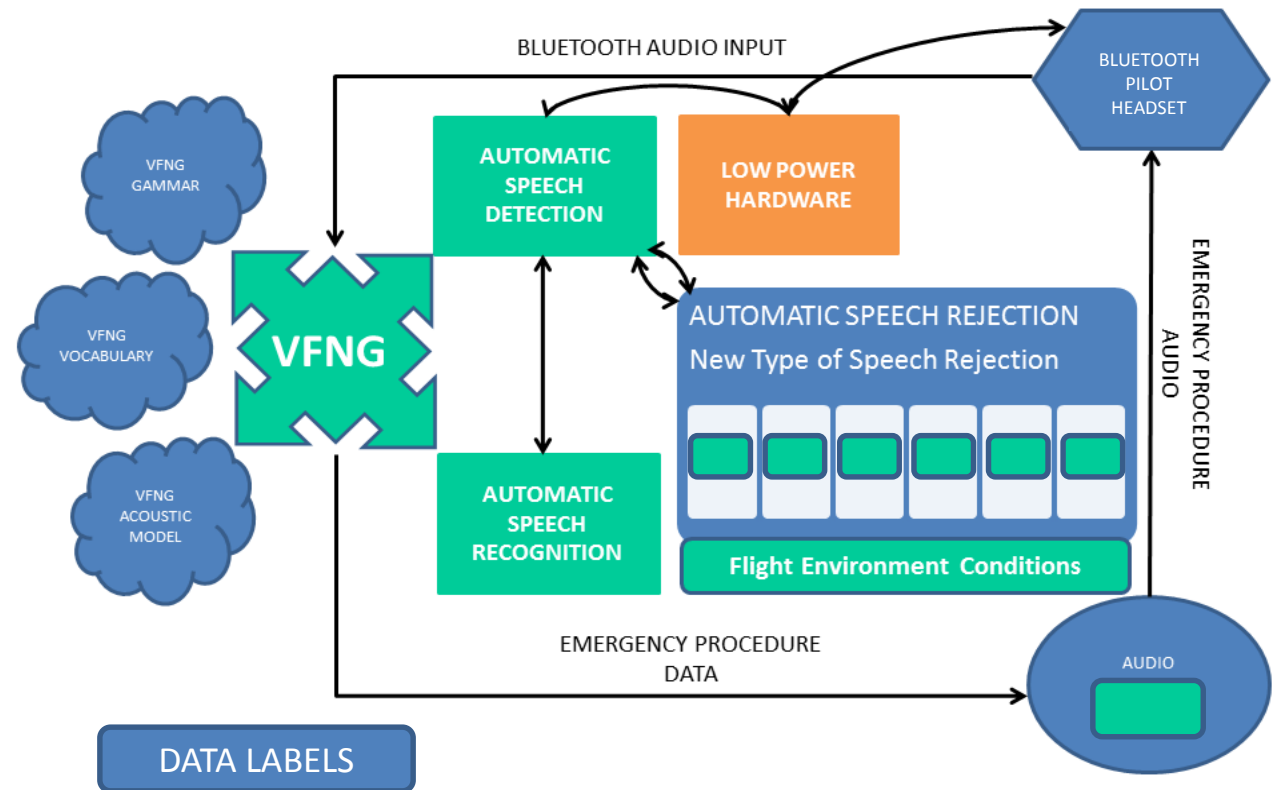
Flight Management System
Voice Function Solutions

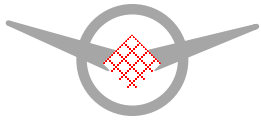| Command Function	Lexicon (syntax / words)		Accuracy (% of command recognition)
Set Altimeter	1800	5400	96.5
Set Altitude	1029	3087	98
Set Arrival	2882	5764	99.63
Set Decision Height Altitude	1600	6400	100
Set Heading	1800	9000	100
Set Mode To	8	24	100
Set Speed	500	2000	100
Set Transponder Code	10104	70728	100
Set Vertical Speed	380	2660	100
Tune Frequency	13536	121824	98
Direct to Airport (i.e.NW)	505	2524	96.94
Direct to Fix (All US AirSpace)	5366	21464	98.6
Direct to WayPoint (i.e.NW)	300	1200	97.07
Landing/Takeoff Clearance	1932	9660	100
Map Centering	20	40	100
Display Format	19	114	100
Display Checklist	22	66	100
ATC Grammar	12789	679000	96.4
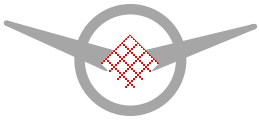
DO AIs DREAM OF ELECTRIC SHEEP?

In an effort to understand how artificial neural networks encode information, researchers invented the Deep Dream technique.

Starting with a network (below) that has been trained to recognize shapes such as animal faces, Deep Dream gives it an image of, say, a flower. Then it repeatedly modifies the flower image to maximize the network's animal-face response.

HIDDEN LAYERS

The network comprises millions of computational units that are stacked in dozens of layers and linked by digital connections. It has been trained by feeding in a vast library of animal reference images, then adjusting the connections until the final response is correct.
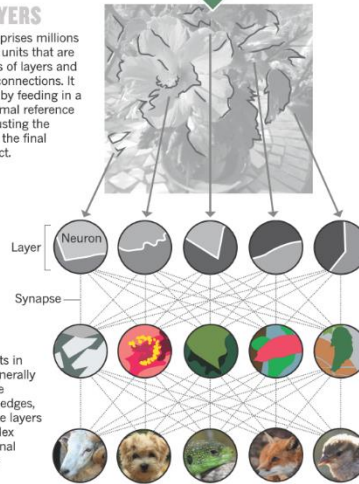
After training, units in the first layers generally respond to simple features, such as edges, while intermediate layers respond to complex shapes and the final layers respond to complete faces.

"The problem is that the knowledge gets backed into the network rather than into us"

After a few iterations, the Deep Dream image begins to resemble a hallucination in which animal faces are everywhere. Other networks will produce images sprouting eyes, buildings or even fruit.

THANK YOU
SAA TEAM
NASA
collaborators