apats2019 SINGAPORE

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"Beyond Freeze and Reset:
Objectively Assessing Crew Interaction
Without Interrupting Task Performance"

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SOCIAL SIGNAL PROCESSING

CUES

WARNINGS

INDICATORS

ALERTS

PROD

PROMPTS

SIGNS

Goal: Establish Standards for effective communication that are:

- Objective
- Data-driven
- Valid and reliable

ASSESSMENT AND AVIATION

Historical fact: **Crew performance has always been continuously evaluated:**

- What do you know?
- What can you do?

ASSESSMENT AND AVIATION

What do you know:

- Written tests
- Oral examinations

What can you do:

- Practical tests in simulator and aircraft
- Observation, review and critique

OBSERVATION, REVIEW AND CRITIQUE:

- Works well for short-duration tasks …but an instrument approach can take 15 minutes or more.
- Works better for individual tasks than team tasks …but airliners are flown by teams
- Requires expert judgment …but even experts can disagree

Achieving reliable standards is problematic

Numerical data, if available, is ordinal only, not scalar.

GATHERING DATA DURING PERFORMANCE

1. What is the aircraft doing?

- Flight data monitoring technology :: aircraft state
- Geographic and navigation data :: aircraft location

2. What is the crew doing?

Individual

- Physiology *(heart rate, respiration, GSR)*
- Eye-tracking
- Facial expression recognition

Crew

- Speech Signal Analysis

SPEECH SIGNAL ANALYSIS

Uses sounds, not words

- Language-agnostic
- Superior accuracy
- Noise-tolerant

Directly assesses team interaction

- Prosodic speech characteristics converge when partners are effectively communicating
- Diverging speech becomes a reliable event marker
- Speech analysis does not interrupt team performance

Speech is converted to data

- Can be fully de-identified
- Team member confidentiality is maintained

SPEECH PROSODY - WHAT IS IT?

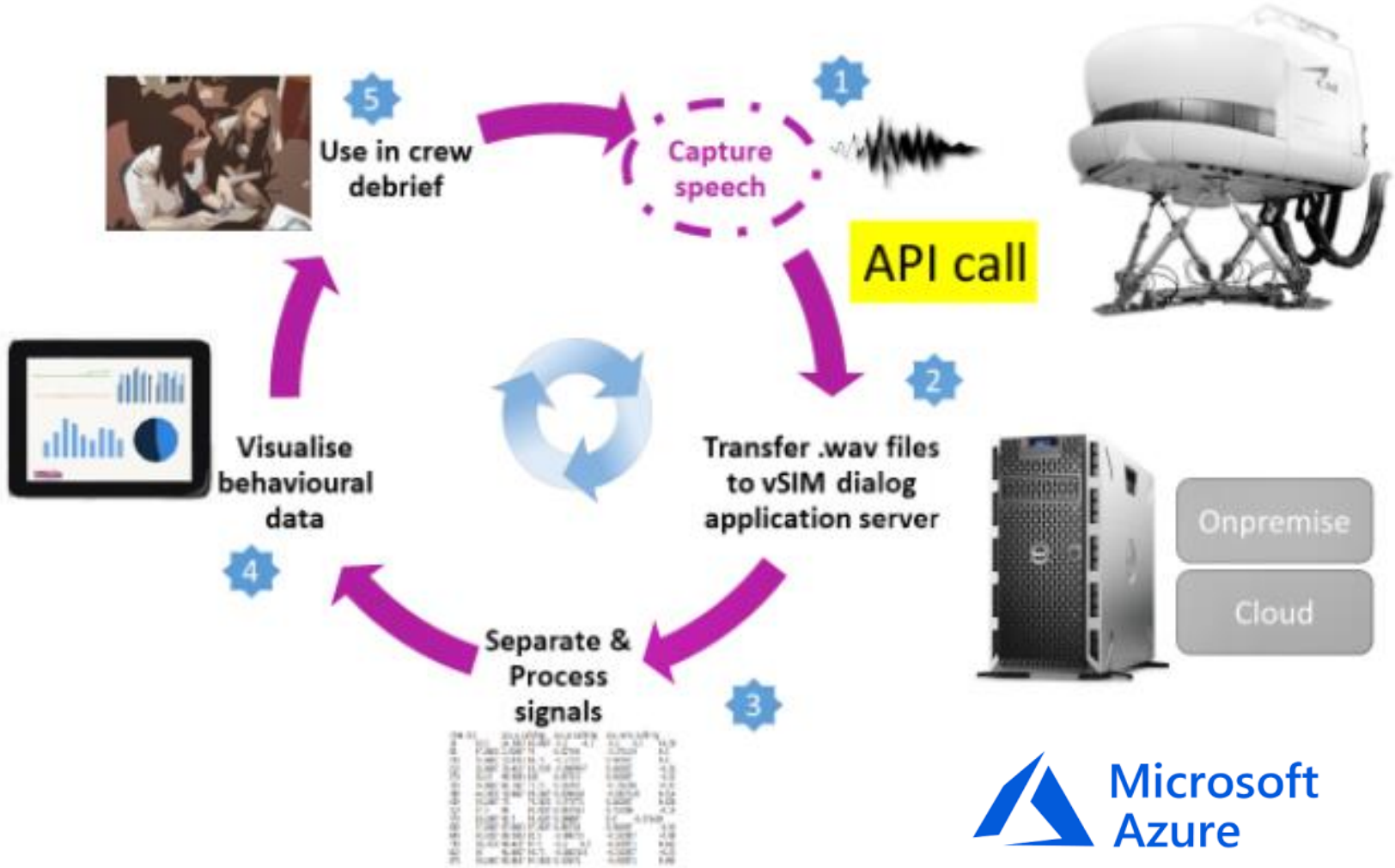
Significant speech prosodic characteristics:

- Pitch and intonation contours
- Voice intensity level
- Speech rate
- Speech timing
- Overlap
- Turn-taking

Speakers accommodate these characteristics to one another when communicating effectively

Each characteristic can be numerically represented

HOW DOES IT WORK?



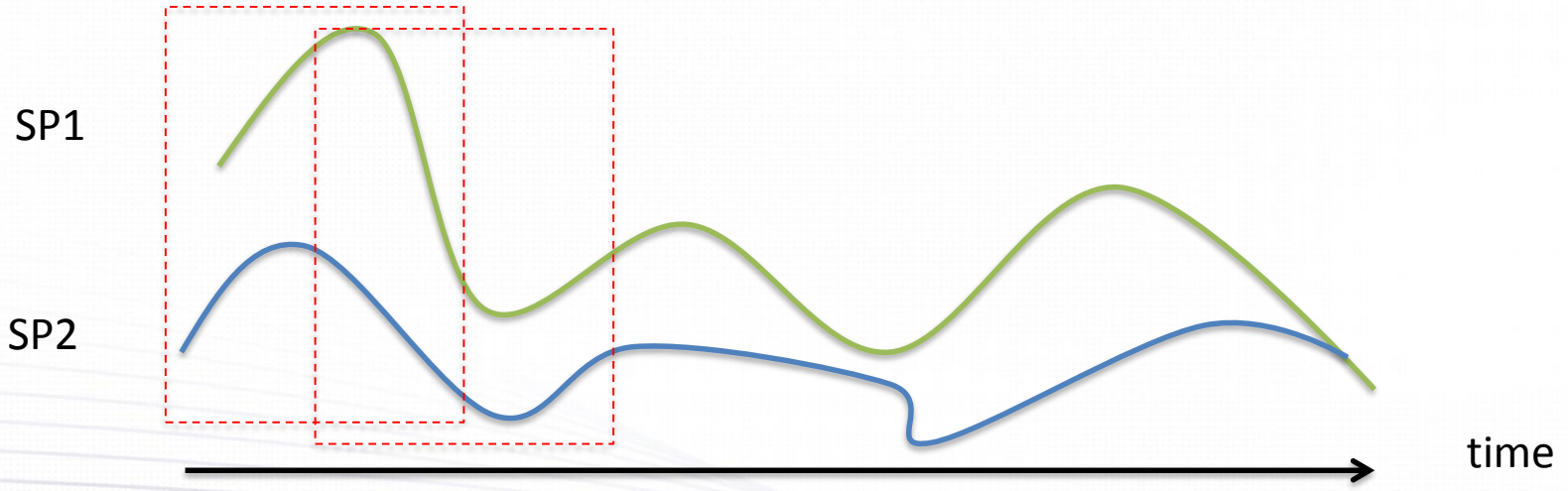
HOW DOES IT WORK?

- **Record speech during task performance with each speaker on a separate channel**
- **Process recordings to extract prosodic features**
- **Output results:**
  - Dashboard
  - JSON File

PROSODIC FEATURE EXTRACTION

Prosodic adaptation *(De Looze et al, 2014)*

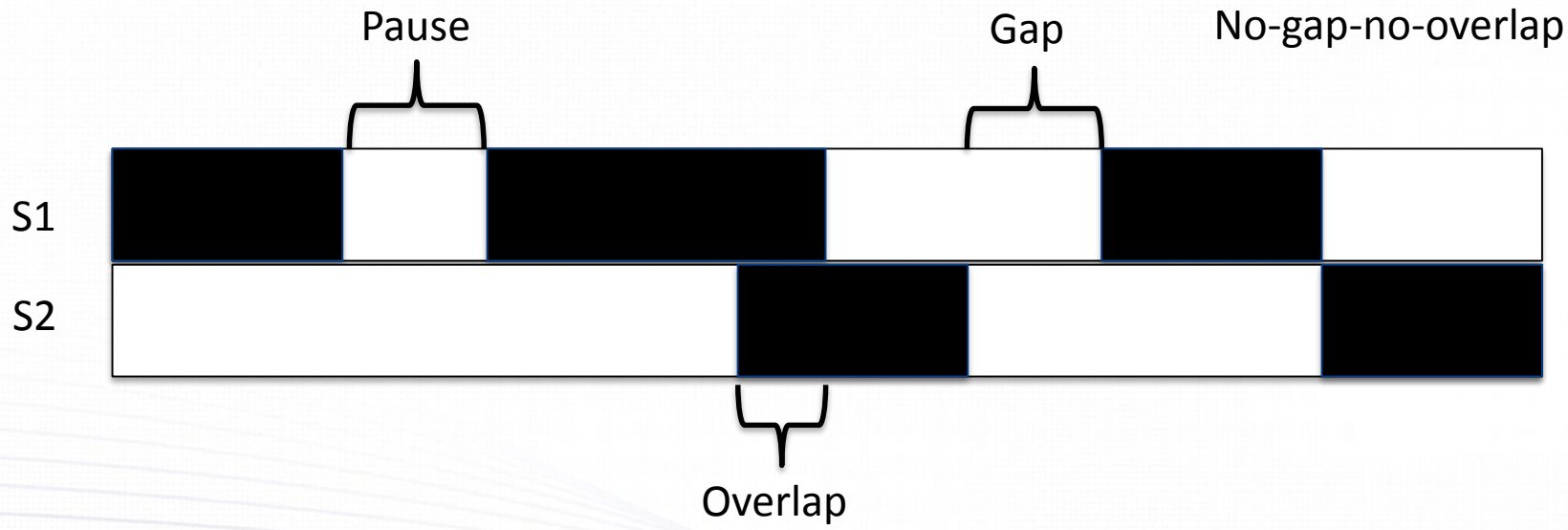
- Features: pitch, energy, tempo
- Tracks the correlation between median values of two speakers within a moving time window



SPEECH FEATURE EXTRACTION

Turn-taking temporal features

- Amount of time talking/ silent/ overlap
- Number and duration of pauses, gaps, overlaps, speech units, turns.



SPEECH PROSODIC ANALYSIS FOR PERFORMANCE ASSESSMENT:

- ✓ Directly assesses team interaction
- ✓ Unobtrusive
- ✓ Does not interrupt performance
- ✓ Generates numerical, scalar data
- ✓ Applicable to both training and operational environments

APPLICATION TO FLIGHT CREW TRAINING

- Crews interact primarily through speech
  - Within the cockpit
  - Within the aircraft
  - Within the Air Traffic Control environment
- Effective Crew Resource Management *(CRM)* relies on effective communication
- Prosodic analysis can identify when communication degrades
- This often marks the occurrence of a significant event

Speech data combined with digital flight data and other sensors provides improved insight into crew behavior and levels of proficiency

Sample use case – A320 (FFS)

Aer Lingus

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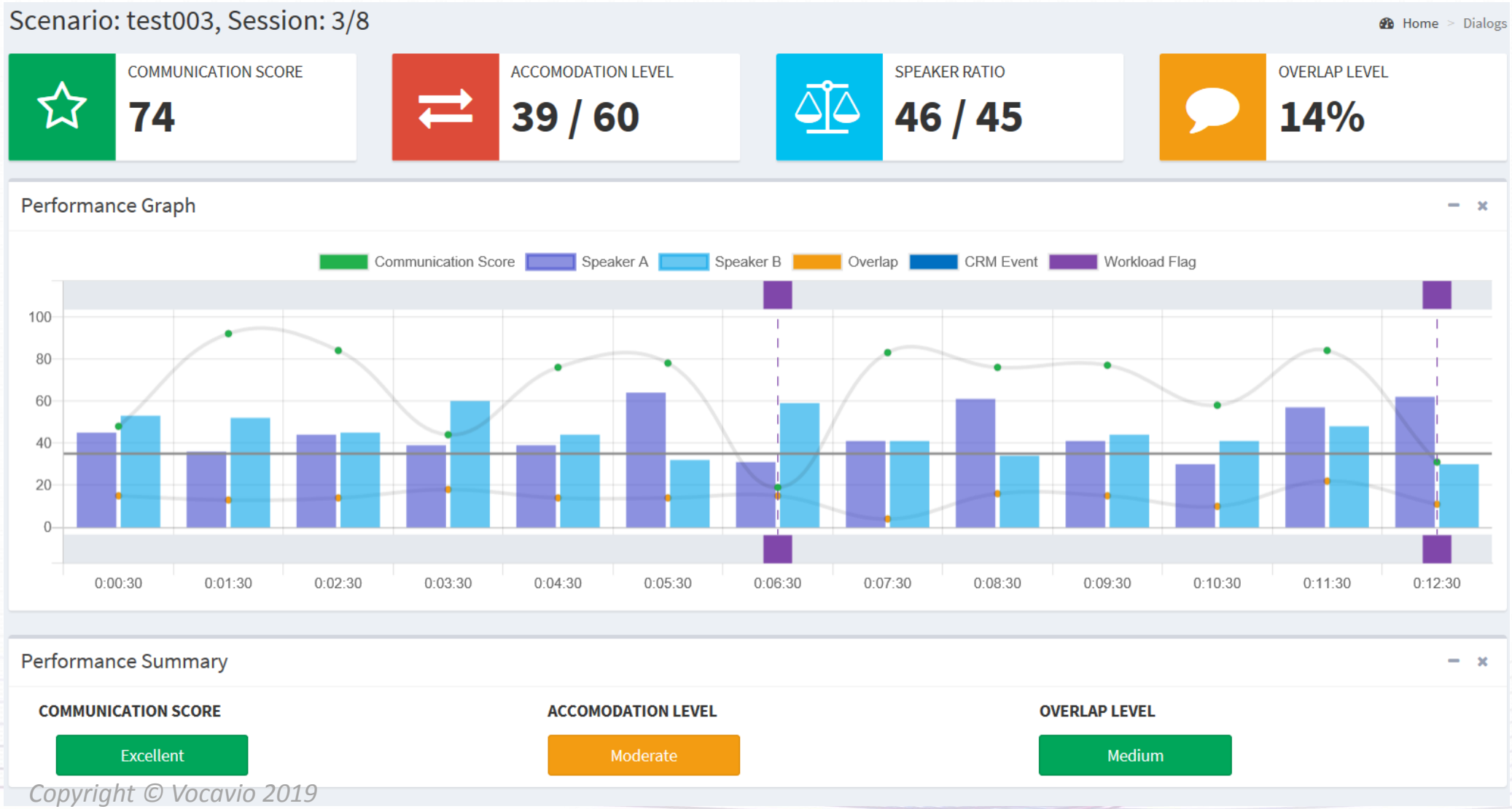

MAIN NAVIGATION

- Dashboard
- Groups
- Dialogs
- Reports

OVERALL SCORE
50

ACCOMODATION
49 / 50

SPEAKING TIME
34 / 43

OVERLAP
13%

Communication Performance

Communication Balance

Audio

Play
Pause

Communication Analysis

Good

THE PATH AHEAD?

- Connecting simulators to the cloud for evidence based training.
- Deploying AI to bring a personalized learning experience to crew members.
- Providing for more data-driven *'self learning'* by crew on flight training devices.
- Data ownership for crew that is portable between airlines.

Microsoft Azure

aws

ABOUT VOCAVIO

- Speech technology company with a presence in Dublin, Budapest and Washington DC
- Focus on integrating speech analysis software to augment simulation & training experience
- Strong technology development and academic team with significant expertise in emerging technologies, speech science and neuroscience
- Deployed in air and land training systems
- Patented technology (US, EUR, CAN) that was developed and scientifically validated at Trinity College Dublin *(with assistance of military and commercial pilots)*
- Industry achievements
  - **Modsim entrepreneur award 2016 by NDIA** (Virginia Beach, USA)
  - **Top 20 cloud technology company 2016** (Clearwater M&A, UK)
  - **Top 20 cloud technology company 2017** (Clearwater M&A, UK)

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OUR MISSION

To provide mission and safety critical environments with software that automatically measures communication & coordination performance.

SIMULATOR

SYNTHETIC

EMBEDDED

Contact us

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