

# CCRI: Establishing a Naturalistic Corpus for Team based Communication/Problem Solving: Fearless Steps Apollo



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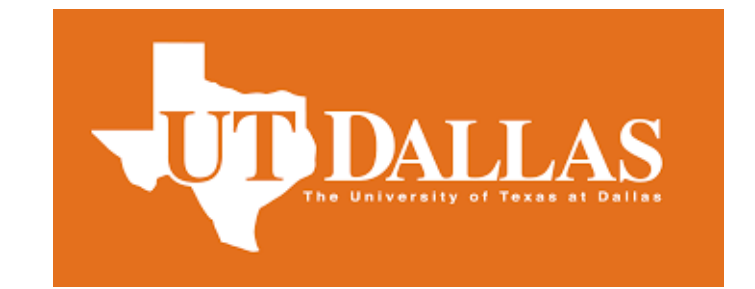
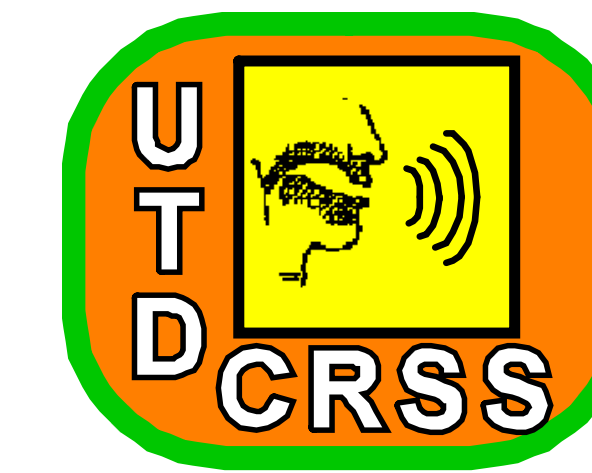
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## 1 Fearless Steps Apollo (FS-Apollo) Corpus

- UTDallas collaborated with NASA to digitize audio tracks
- Data from Apollo 11, 13, 1 and Gemini missions were digitized.
- +19,000 hours of data available for research & analysis.
- CRSS-UTDallas: needed to develop:
  - new digitizing solution for 30-track tapes,
  - diarization pipeline to process 19,000hrs audio streams 24/7

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## 2 Apollo: Audio Interaction Analysis

30 Channel Audio

Backroom Audio Loops

NASA SoundScriber Audio Capture

Seat Position: Operator ID tracking (3 person's in 8-9hr shifts)

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## 3 Communication Protocols

- Effective communication protocols between +450 speakers
- Extracting salient events, i.e. "hotspots", directly from audio can be vital for efficient information retrieval and parsing through Apollo mission audio.

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## 4 Challenge Series Overview

- Fearless Steps Challenge:**
  - Phase-1:
    - Focus: Unsupervised development
    - Ground-Truth: 20hrs (Dev)
    - Evaluation: 20hrs (5-ch Apollo-11)
  - Phase-2:
    - Focus: Supervised development
    - Ground-Truth: 75hrs (Train + Dev)
    - Evaluation: 25hrs (5-ch Apollo-11)
  - Phase-3:
    - Focus: System generalization
    - Ground-Truth: 75hrs (Train + Dev)
    - Evaluation: 34hrs (20hrs in-domain seen channels + 9hrs unseen channel + 5hrs out-of-domain Apollo-13 mission audio)

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## 5 FS-Apollo Dataset

- 100hr: 5 time-synchronized channels, 3 mission stages
- Stage: Lunar Landing
  - Time: 10 hours
  - Mission Stage Audio for FS Challenge: 50hrs
- Stage: Lunar Walk
  - Time: 5 hours
  - Mission Stage Audio for FS Challenge: 25hrs
- Stage: Lift-Off
  - Time: 5 hours
  - Mission Stage Audio for FS Challenge: 25 hours

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## 6 FSC Global Participation

**Fearless Steps Challenge Series:**

- Participation: 250 Research organizations from 50 countries using FSC data
- 350+ System Submissions from 45 teams evaluated!

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## 7 Proposed CRSS-UTDallas Solution

(i) Communication Overview for Apollo-MCC

(ii) Multi-Channel Diarization Speech Processing

(iii) CRSS-UTD DIARIZATION OUTPUT: Apollo Knowledge Extraction Per Audio Stream

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## 8 Speaker Tracking in Apollo 11: Fearless Steps

Image of finding Waldo

Image of Mission Control (MOCR)

- Speaker Tracking: Identifying a desired speaker and track their speech from a group of speakers in an audio.
- Our Focus: speakers from Mission Control Room (MOCR).

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## 9 Varying Speaker Duration on Fearless Steps Corpus

Lift Off Lunar Landing Lunar Walking

- Total number of speakers in Lift Off: 52
- Speakers common in: Lift off and Lunar Landing: 14, Lift off and Lunar Walking: 19
- Total number of speakers in Lunar Landing: 92
- Speakers common in: Lunar Landing and Lift Off: 14, Lunar Landing and Lunar Walking: 16
- Total number of speakers in Lunar Walking: 37
- Speakers common in: Lunar Walking and Lift Off: 19, Lunar Walking and Lunar Landing: 16

Phases	Speech content from primary channels in hours					
	EECOM	FD	GNC	MOCR	NTWK	Total
Lift Off	0.54	0.42	0.31	0.52	1.23	3.02
Lunar Landing	1.89	1.05	1.97	3.75	3.25	11.91
Lunar Walking	0.57	0.95	0.37	0	0.58	2.47

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## 10 S-o-I vs. Non S-o-I: FS Corpus

T-SNE Representation of Speaker Utterances for Mission control and Speakers of Interest

**Speakers of Interest (S-o-I) vs Non S-o-I**

- Interaction between SOI vs Non SOI across complete 100 hours of Fearless Steps
- Flight Director: Gene Kranz
- Capsule Communicator: Charles Duke
- Commander: Neil Armstrong
- Commander Module Pilot: Michael Collins
- Lunar Module Pilot: Buzz Aldrin

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## 11 Conversational Analysis

Parameter	Value
Conversation Count	10
Word Count	1050
# Turns Taken	60
Topic of discussion	Lift-off

Parameter	Value
Sentiment	Positive
Emotion	Positive
Stress Levels	High

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## 12 https://app.exploreapollo.org/

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