NASA-TSGC

(TEXAS SPACE GRANT CONSORTIUM)

Dr. C

Principal Investigator

TEXAS STATE ®

INGRAM SCHOOL OF ENGINEERING

TSGC GRANTS ARE COMPETITIVE

- We apply for a grant – it is not guaranteed
- We apply for our first, second, and third choice of projects

- We know whether or not we were awarded a grant, and our project topic, by Wednesday September 13th

- If we do not get an award, those of you who applied for the NASA project will be placed on your 2nd or 3rd choice projects

THE PROJECT CHOICES

- TDC-32: Dual-Use Wideband Microphone Array
- TDC-86: Integrated Camera & Lighting System Optimization Project for Lunar Surface Rover
- TDC-87: Luminaire Intelligent Tracking (LIT)

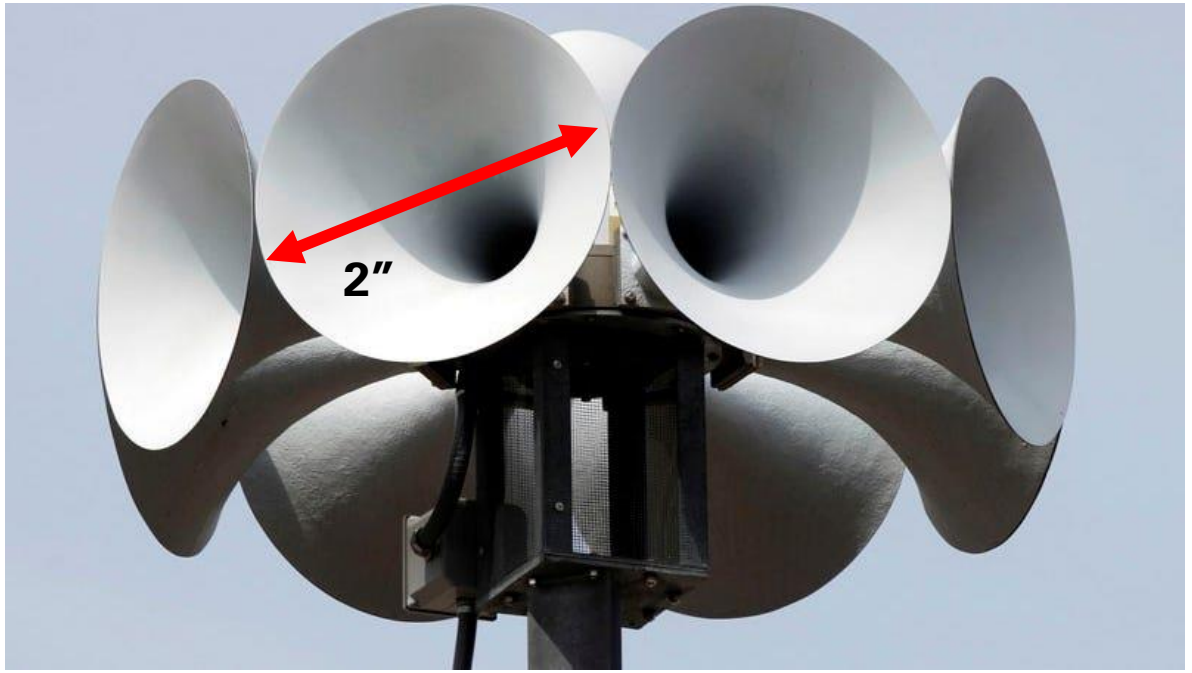
TDC-32: Dual-Use Wideband Microphone Array

- Microphone array with two simultaneous “channels”:
  1. Astronaut communications in 200-6,000 Hz band
  2. Ultrasonic in 20-85kHz band to detect and locate air leaks
- We’ve done this project before and learned that the *MEMS microphones don’t detect ultrasonic signatures more than a couple feet away*

- **Possible improvements for this year**:
  - Continue to improve DSP capabilities
  - 3D print ultrasonic exponential horns to improve sensitivity by 15-20dB
  - Address stretch goals

TDC-32: Dual-Use Wideband Microphone Array

- Shown below: exponential horns for tornado siren
- Our horns would be ~2” wide – and there would be more of them if the concept is proven



TDC-32: Dual-Use Wideband Microphone Array

- **Goal**: A non-tracking dual-wideband MEMS-based microphone array system "proof-of concept" prototype that can provide for hands-free voice communications as well as detect at least one anomaly in the equipment/habitat such as a failing pump or a leak in a pressure shell.

- If a leak is detected, the system will announce both auditory and visually the warning that a leak has been detected.

- The warning will occur at a 1 Hz rate and will be silenced when the annunciation is acknowledged by the user.

- Performance will be determined by conducting speech intelligibility testing of speech recorded using the array microphone.

TDC-32: Dual-Use Wideband Microphone Array

Stretch goals:

1. Microphone array can provide angle of incidence information relative to the array normal axis for localization of an ultrasonic sound source.
2. Use beam forming to track/follow a moving speech source to maximize speech to noise ratio.
3. Provide synthesized or recorded speech annunciations indicating detection of ultrasonic noise and location or direction
4. Provide a VoIP interface for audio, warning annunciation and acknowledge commands.

Link to NASA-TSGC project description:

https://drive.google.com/file/d/13nCQdv4aIN5iztM76DhrijiGQnYCM2zI/view?usp=share_link

TDC-86: Integrated Camera & Lighting System Optimization for Lunar Surface Rover

Next-gen NASA Lunar Rover

TDC-86: Integrated Camera & Lighting System Optimization for Lunar Surface Rover

- The visibility of the objects in the field of view of the camera requires appropriate illumination, and quality imagery requires a balancing of both the exposure settings on the camera and the illumination field.

- In many cases, cameras are paired with illumination sources to maximize the effectivity of the camera, and sophisticated cameras use software to dynamically manage camera exposure settings to maintain image quality requirements.

- When developing an integrated camera and lighting system, it is important to understand the operational task environment, otherwise the system will not work as desired.

TDC-86: Integrated Camera & Lighting System Optimization for Lunar Surface Rover

- Your system needs to operate under total darkness, with other artificial lighting systems in the area, with direct high intensity sunlight, and produce quality imagery even of targets that are in shadow, even though other parts of the camera image are not.

- Additionally, your system needs to produce quality imagery, even though the surface materials within the image could be dark like asphalt, as diffuse white as canvas, as shiny as polished aluminum, or behave like retroreflectors.

- The goal of your project is to utilize programmable light sources and a programmable camera system, to determine a range of system geometries and system settings that facilitates quality imagery despite a range of material surface types and patterns despite a range of environmental lighting conditions.

TDC-86: Integrated Camera & Lighting System Optimization for Lunar Surface Rover

Deliverables: System specs, software or methods, system configuration, test plans, imagery, and explanation each configuration and why some methods worked, and others did not.

Link to NASA-TSGC project description:

https://drive.google.com/file/d/1OiFqfbmq7uNz1Jz0gM7ho1mP_LmEHvS0/view?usp=share_link

TDC-87: Luminaire Intelligent Tracking (LIT)

Automotive headlamp comparison

TDC-87: Luminaire Intelligent Tracking (LIT)

- The purpose of applying lighting to any vehicle is to allow for situational awareness for the crew, however, adaptive lighting applied to the external body of a vehicle would increase crew visibility, decrease vehicle power usage, and enable crew autonomy during EVA operations.

- Adaptive lighting integrates a high-definition (HD) micro-LED matrix, laser spot beam and camera(s) to provide pixel-level digital control of the system.

- Computer vision extracts surface information to improve the precision & accuracy of the lighting system and will act as a glare-free, hands-free supplemental lighting source while crew is traversing the lunar terrain or performing EVA tasks.

- This vehicle exterior adaptive lighting system has a wide-range of applicability for lunar surface operations, but its main purpose is to keep the crew safe and aware of their surroundings.

TDC-87: Luminaire Intelligent Tracking (LIT)

- While we may have an idea the natural lighting conditions present on the far side of the moon, we do not have the experience or integrated lighting architecture to traverse safely in the shadowed regions.
- Adaptive lighting can close the architecture gap and mitigate operations and performance risks for Artemis missions.
- LED matrix technology has been used in roadway lighting and vehicle headlights to provide navigational guidance, pedestrian/object detection and minimize glare for oncoming drivers.
- In an EVA application, this technology will detect crewmembers during surface exploration, act as a spotlight to increase crew's situational awareness, and enhance our exploration capabilities with a modular lighting solution applicable to all vehicles supporting an EVA.

TDC-87: Luminaire Intelligent Tracking (LIT)

Deliverables:

- Prototype CAD models, schematics, & software
- Quantifiable evidence of performance and power conservation capabilities compared to conventional lighting systems

Time and funding permitting deliverables:

- VR simulation environment utilizing adaptive lighting concept
- Prototype demonstration

Link to NASA-TSGC project description:

https://drive.google.com/file/d/1hX6fECVkK-i1ZkJ7pBEFv-K6-VGcf4BS/view?usp=share_link

THANK YOU

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