Multimodal Display Rational

High-workload, fast-paced, and degraded sensory environments (e.g., during EVA and-tendonics operations) are the likely to benefit from multimodal displays that can:

- Enhance situation awareness and task performance by maximizing the effectiveness of different sensory channels
- Be effective in appropriate interaction between modalities
- Play an important role informing interface guidelines for long duration exploration missions (LDEMs) requiring greater crew autonomy with increased dependence on spacecraft information systems for both routine and time/safety critical tasks.

Benefits of Multimodal Displays

- Increased bandwidth: Increase in the amount of information that can be transmitted over a fixed time period.
- Cross-modal spatial and temporal links lead to enhanced facilitation of information transmission.
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- Clear inference is drawn from sensory channels that work best for the task at hand.
- Harmony: Presenting related information in different sensory channels reduces risk that an event will be missed or be affected by information overload.
- Adaptivity: Presenting information in an alternative modality when other sensory channels become temporarily or permanently unavailable.

Multisensory Integration

Evidence from both-behavioral & neuroscience research demonstrates woven sensory-motor interplay between visual, auditory, and somatosensory systems. Inhibition, depression or excitation in the expected channel due to adaptation, expectation, or context.

- Modality: Modality is a key input for attention allocation.
- Temporal factors: Temporal factors can play a role in the facilitation and depression of information.
- Adaptivity: Adaptivity is a key input for attention allocation.
- Sensory integration: Sensory integration is a key input for attention allocation.

Examples of Current Standards & Guidelines

- ISO 9241-422 (2009): International standard of multimedia design principles that focus on the impact of each sensory channel on user experience, including visual, auditory, and tactile.
- ISO 40149-1 (2011): European standard for multimodal interfaces and guidelines that address a variety of topics related to the design of multimodal interfaces.

Research Recommendations

- Incorporate a multimodal interface into an HMD or visual display that allows users to access different sensory modalities simultaneously.
- Ensure that users can easily switch between sensory modalities.
- Design experiments that evaluate the effectiveness of multimodal displays in real-world scenarios.

Reference