SECTION I

PIMS Interaction with Principal Investigator Teams

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MEIT-2001

- **Microgravity Environment Interpretation Tutorial (MEIT)**
  - ***Purpose:***
    - **Describe and analyze the significant features of the microgravity acceleration environment for the Principal Investigator teams and other interested parties.**
  - ***Content*:**
    - **PIMS Interaction with Principal Investigator Teams**
    - **Working in Microgravity Environment: "A Primer"**
    - **Accelerometer Systems Description**
    - **Analysis of Acceleration Data**
    - **Different Microgravity Platform Signatures**
    - **ISS Microgravity Requirements and Current Environment Predictions**
    - **Fundamentals of Microgravity Vibratory Isolation and a Survey of Microgravity Vibratory Isolation Systems**
    - **Impact of the Microgravity Environment on Experiments**
    - **Predicting Residual Acceleration Effects on Space Experiments**
    - **Developing Microgravity Tolerance Specifications**

PIMS' Missions are:

- **To assist PI teams in understanding different aspects of measuring and interpreting the microgravity environment of various platforms and ground-based facilities.**

- **To provide interpretation of the microgravity environment and perform detailed analyses for general and specialized characterization.**

- **To educate PIs, Project scientists and associates about the microgravity environment through the Microgravity Environment Interpretation Tutorial (MEIT) and the MicroGravity Measurements Group (MGMG) gatherings.**

Principal Investigator Microgravity Services (PIMS)

- PIMS performs the project scientist role for the accelerometer instruments
  - PIMS works with the science experiment principal investigators, project scientists, and other program participants to assist in the understanding and use of the acceleration data and information
  - PIMS products include general and specific analyses, vehicle characterization, and mission summary reports
  - PIMS conducts the Microgravity Measurements Group (MGMG) meetings to foster interchange of data and information within the microgravity environment community and to the microgravity science community
  - PIMS conducts the Microgravity Environment & Interpretation Tutorial (MEIT) to convey significant features of the microgravity acceleration environment to the microgravity Principal Investigator teams and other interested parties

Principal Investigator Microgravity Services (PIMS)

Support NASA's Microgravity Research Program Principal Investigators (PIs) by providing acceleration data processing, analysis, and interpretation for a variety of reduced gravity carriers and ground-based facilities, such as:

- **Space Shuttle**
- **Parabolic Flight Aircraft (KC-135)**
- **Sounding Rockets**
- **Drop Towers**
- **Mir**
- **ISS**
- **Ground Testing**
- **Microgravity Emission Lab (MEL)**

Principal Investigator Microgravity Services (PIMS)

Analyze acceleration data from a number of acceleration measurement systems, such as:

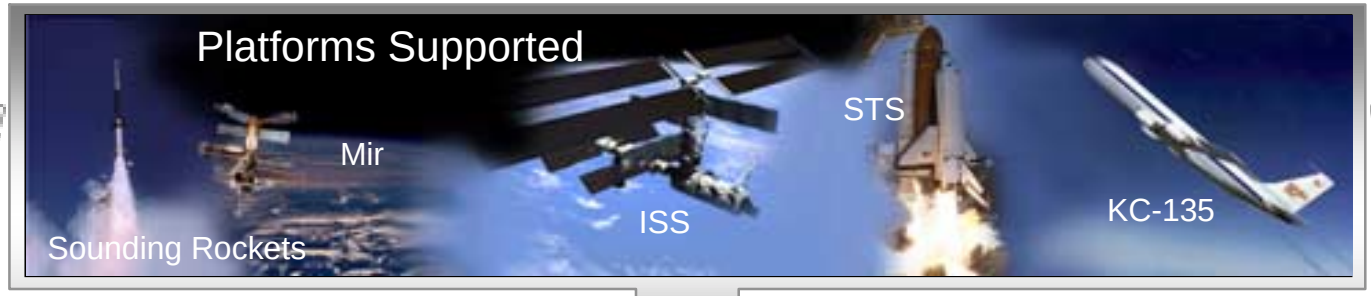
- **Space Acceleration Measurement System (SAMS)**
- **SAMS for ISS**
- **Space Acceleration Measurement System for Free-Flyers (SAMS-FF)**
- **Orbital Acceleration Research Experiment (OARE)**
- **Microgravity Acceleration Measurement System (MAMS)**

Principal Investigator Microgravity Services (PIMS)

Support the following areas:

- **Biotechnology**
- **Combustion Science**
- **Fluid Physics**
- **Materials Science**
- **Fundamental Physics**
- **Astronaut Office**
- **International Partners**
- **Vehicle Dynamics**

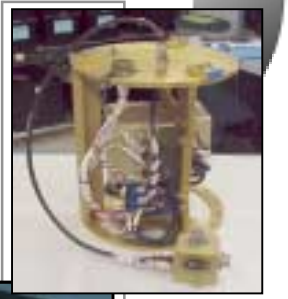
PIMS Interaction with Principal Investigator Teams



SAMS

OARE

SAMS - FF



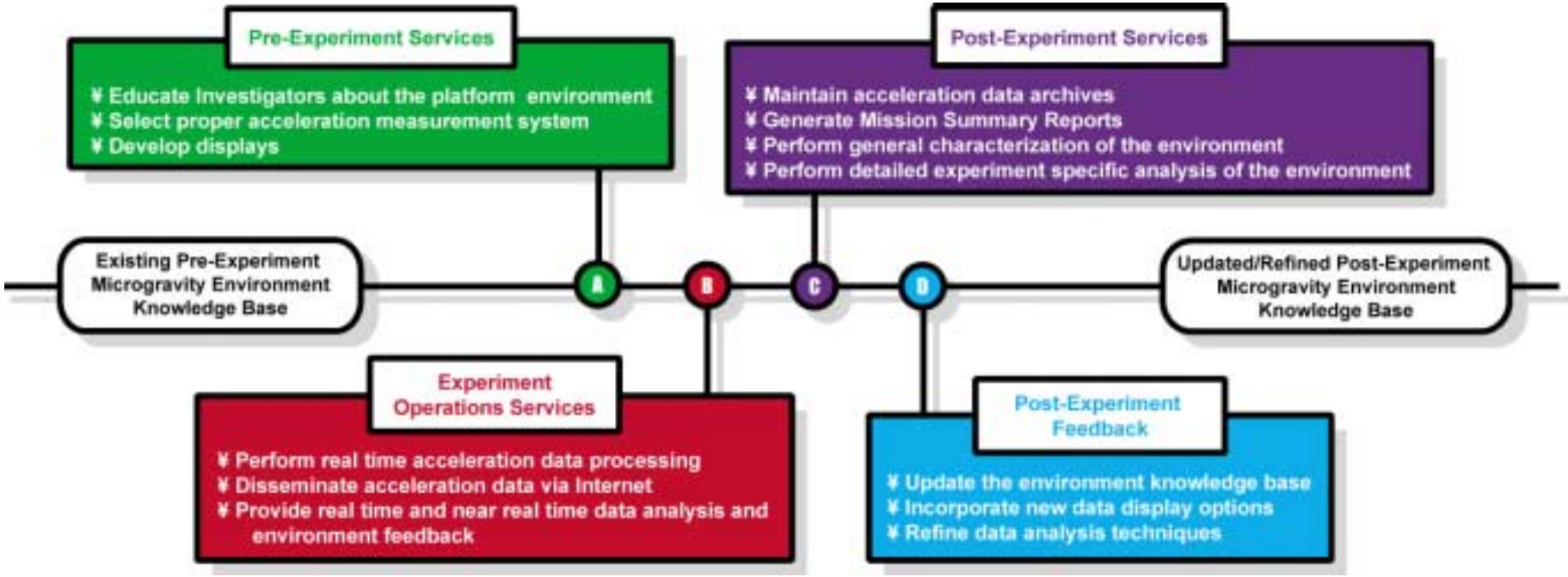
Science Supported

- Combustion
- Fluid Physics
- Materials
- Fundamental Physics
- Vehicle Dynamics
- Biotechnology

Microgravity Emission Lab

SAMS-II

PIMS Functions During Experiment Life Cycle



PIMS' support to PIs includes the following:

- **Receive, Process, Analyze, and Interpret Accelerometer Data to Characterize the Microgravity Environment of Various Platforms for the Investigative Teams.**

ANALYSIS SUPPORT:

- **Monitor the Microgravity Environment in Real Time to Support Their Operation (when needed)**
- **Provide Real Time Displays**
- **Provide Near Real Time Support**
- **Provide Post Mission Support**
- **Provide a Near Real Time ISS Microgravity Environment Monitoring System (ISS MEMS) Via WWW**

PIMS' support to PIs includes the following:

DATA SUPPORT:

- Provide easy access to plots of acceleration data via WWW
- Provide customized format plots to PI teams based on pre-mission inputs
- Publish Summary Report of Mission Acceleration Measurements

EDUCATIONAL:

- Annual Microgravity Environment Interpretation Tutorial (MEIT)
- Annual MicroGravity Measurements Group (MGMG) gatherings

PIMS Plotted Data Options

Display Format	Regime(s)	Notes
Acceleration versus Time	Transient, Quasi-Steady, Vibratory	• precise accounting of measured data with respect to time; best temporal resolution
Interval Min/Max Acceleration versus Time	Vibratory, Quasi-Steady	• displays upper and lower bounds of peak-to-peak excursions of measured data • good display approximation for time histories on output devices with resolution insufficient to display all data in time frame of interest
Interval Average Acceleration versus Time	Vibratory, Quasi-Steady	• provides a measure of net acceleration of duration greater than or equal to interval parameter
Interval RMS Acceleration versus Time	Vibratory	• provides a measure of peak amplitude for pure sinusoids
Trimmed Mean Filtered Acceleration versus Time	Quasi-Steady	• removes infrequent, large amplitude outlier data
Quasi-Steady Mapped Acceleration versus Time	Quasi-Steady	• use rigid body assumption and vehicle rates and angles to compute acceleration at any point in the vehicle
Quasi-Steady Three-Dimensional Histogram (QTH)	Quasi-Steady	• summarize acceleration magnitude and direction for a long period of time • indication of acceleration "center-of-time" via projections onto three orthogonal planes

PIMS Plot Options

Display Format	Regime(s)	Notes
Power Spectral Density (PSD) versus Frequency	Vibratory	• displays distribution of power with respect to frequency
Spectrogram (PSD versus Frequency versus Time)	Vibratory	• displays power spectral density variations with time • identify structure and boundaries in time and frequency
Cumulative RMS Acceleration versus Frequency	Vibratory	• quantifies RMS contribution at and below a given frequency
Frequency Band(s) RMS Acceleration versus Time	Vibratory	• quantify RMS contribution over selected frequency band(s) as a function of time
RMS Acceleration versus One-Third Frequency Bands	Vibratory	• quantify RMS contribution over proportional frequency bands • compare measured data to ISS vibratory requirements
Principal Component Spectral Analysis (PCSA)	Vibratory	• summarize magnitude and frequency excursions for key spectral contributors over a long period of time • results typically have finer frequency resolution and high PSD magnitude resolution relative to a spectrogram at the expense of poor temporal resolution

Principal Investigator Microgravity Services

Acceleration Measurement WWW links

- Microgravity Science Division at NASA Glenn Research Center
  - http://microgravity.grc.nasa.gov
- NASA Glenn Acceleration Measurement Program
  - http://microgravity.grc.nasa.gov/MSD/MSD_htmls/acceleration.html
- Principal Investigator Microgravity Services Home Page
  - http://microgravity.grc.nasa.gov/MSD/MSD_htmls/PIMS.html

Microgravity Environment References

- Microgravity Environment Description Handbook TM
  - Compilation of major microgravity environment disturbances, their sources, and their effects as measured on the Shuttle Orbiters and the Mir Space Station
  - NASA TM-107486 July 1997
  - http://www.grc.nasa.gov/WWW/MMAP/PIMS/HTMLS/Micro-descpt.html
- Acceleration Data Analysis and Presentation Techniques TM
  - Detailed description of acceleration data analysis techniques
  - http:// www.grc.nasa.gov/WWW/MMAP/PIMS/HTMLS/adapt.html
- Mission Summary Reports
  - Mission specific characterizations for various Shuttle and Mir missions
  - http:// www.grc.nasa.gov/WWW/MMAP/PIMS/HTMLS/reportlist.html