Section 2:

PIMS Interaction with Principal Investigator Teams

Presented by

Kenol Jules

PIMS Project Scientist

NASA Glenn Research Center

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 such as:

- **Space Shuttle**
- **Parabolic Aircraft (KC-135)**
- **Sounding Rockets**
- **Drop Towers,**
- **Mir**
- **ISS**

Principal Investigator Microgravity Services (PIMS)

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

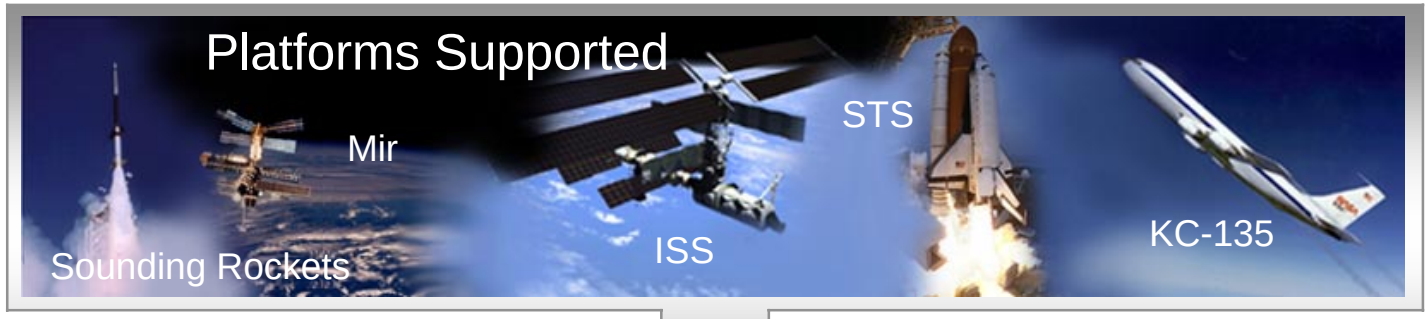
- **Space Acceleration Measurement System (SAMS)**
- **SAMS-II**
- **Space Acceleration Measurement System for Free-Flyers (SAMS-FF)**
- **Orbital Acceleration Research Experiment (OARE)**
- **Microgravity Acceleration Measurement System (MAMS)**

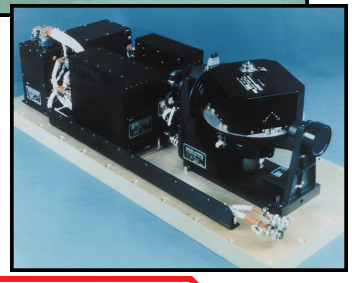
Principal Investigator Microgravity Services (PIMS)

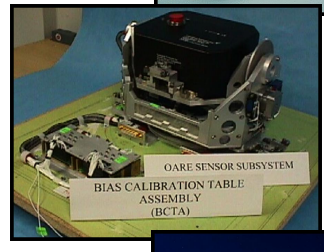
Support various scientific disciplines such as:

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

PIMS Interaction with Principal Investigator Teams



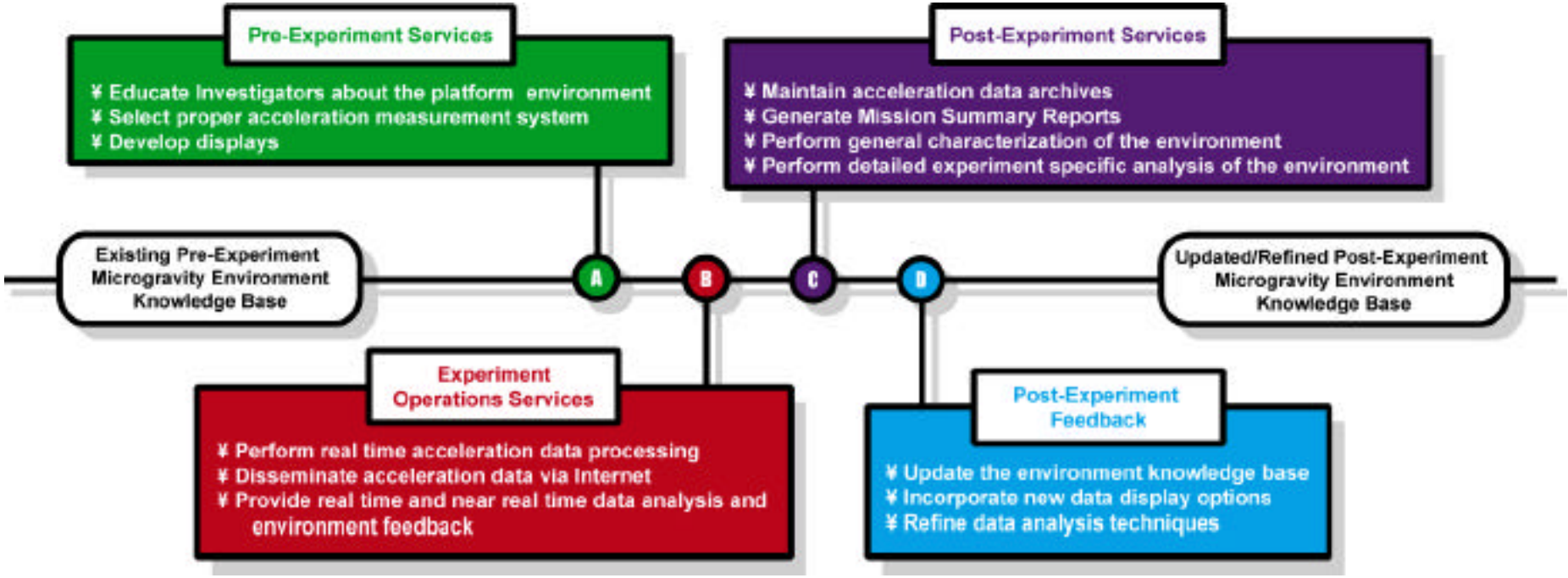




Science Supported

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

PIMS Functions During Experiment Life Cycle



PIMS' support of Principal Investigator Teams:

- Process, analyze, and interpret accelerometer data to characterize the microgravity environment of various platforms for the Principal Investigator Teams.
- Maintain archive of acceleration data from various microgravity platforms such as Mir, Space Shuttle, KC-135, sounding rockets and ISS.
- Store and distribute acceleration data:
  - CD-ROM
  - Internet file server
  - World Wide Web (WWW)
  - Mission reports
  - NASA Technical Memoranda (TM)

PIMS' support of Principal Investigator Teams:

- Provide PI teams easy access to plots of acceleration data via WWW
- Provide customized format plots to PI teams based on pre-mission inputs
- Provide near real time and off line access to acceleration data to PI teams
- Provide PI teams anonymous FTP access to processed acceleration data files
- PI can request plotted data or data files via the WWW
- PI can submit electronic request for data processing

Analyze acceleration data

- Development and maintenance of the Microgravity Environment Description Handbook (MEDH), NASA TM-107486
  - overview of known microgravity environment disturbances cross-referenced by carrier, source, acceleration magnitude, and frequency
  - Generation of Mission Summary Reports (MSRs)
  - analyze data from a given mission
  - summarize any unique features in the data
  - update the knowledge base in the MEDH
- various NASA Technical Memoranda (TM)
- Analysis based on PI specific requests
- Information on WWW (MEDH, MSRs, etc.)
  - http://www.lerc.nasa.gov/WWW/MMAP/PIMS

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

Provide data processing tools

- Perform binary to ASCII conversions
- Access, retrieve, and display acceleration data using the same set of tools developed by the PIMS project
- Each PI has control over his / her own displays
- Offline analysis requests is submitted via a web-based system
  - processed results are made available within a given period of time
- Real-time displays are available via the WWW

PIMS support during ISS operation

- PIMS will receive, process, and store acceleration data for SAMS-II and MAMS data starting with flight 6A operations
- A universal storage format will be used for data storage
- Real-time data plots of the various available accelerometers will be available via the PIMS WWW page
- Offline access to plotted data and analysis capabilities available through PIMS and the PIMS WWW page
- General and specialized characterization of the ISS microgravity environment

In Closing, PIMS' mission is:

- To assist PI teams in understanding different aspects of measuring and interpreting the microgravity environment.

- 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 MEIT tutorials and MGMG gatherings.

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/accel_meas.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