



ILRS Data Analysis Survey

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2003 ILRS Data Analysis Survey

1. What general areas of study are underway at your center that rely on laser ranging data?
2. Which targets are you currently using in your analysis work?
3. What are your applications for each target?
 - Artificial Satellites
 - Earth Orientation (EOP)
 - Reference Frame (GM, Earth center of mass)
 - Gravity Field (static and time varying)
 - Tides
 - Comparison with other techniques
 - Improved orbit development
 - Station position/motion
 - POD (mission specific)
 - Q/C of stations
 - Spacecraft models
 - Gravitational physics tests, relativity
 - Other
 - Lunar Reflectors
 - Lunar rotation
 - Lunar composition
 - Lunar Love numbers
 - Excitation of librations
 - Precise solar system ephemerides
 - Other
4. Are you receiving sufficient data volume?
5. Are you receiving sufficient data coverage?
6. Are the data of sufficient accuracy for your applications?
7. What other satellites do you plan to use in the future?
8. What do you need that you are not getting?
9. How do you access the data (CDDIS, EDC, etc)? Is it easy?
10. What other comments or suggestions do you have regarding the ILRS data?



Analysis Center Responses

- Sent to Analysis and Associate Analysis Center in July 2003
- Received 21 responses (total of 28 ACs and AACs)
- SLR Analysis Centers
 - ◆ DUT/DEOS (Netherlands)
 - ◆ U. Texas/CSR (USA)
- SLR Associate Analysis Centers
 - ◆ ASI (ITALY)
 - ◆ BKG (Germany)
 - ◆ CLG/BAS (Poland)
 - ◆ CODE (Switzerland)
 - ◆ CRL (Japan)
 - ◆ DGFI (Germany)
 - ◆ ESA/ESOC (Germany)
 - ◆ FFI (Finland)
 - ◆ GA (Australia)
 - ◆ GFZ (Germany)
 - ◆ GSFC/RITSS (USA)
 - ◆ IPA (Russia)
 - ◆ NASDA (Japan)
 - ◆ NERC (UK)
 - ◆ Newcastle (UK)
 - ◆ OCA/CERGA (France)
 - ◆ Shanghai (China)
- LLR Analysis Centers
 - ◆ IfE/FESG (Germany)
 - ◆ JPL (USA)
- No Responses
 - ◆ GAOUA (Russia)
 - ◆ Graz (Austria)
 - ◆ IA (Russia)
 - ◆ IMVP (Russia)
 - ◆ MCC (Russia)
 - ◆ Paris LLR (France)
 - ◆ U. Texas LLR (USA)

Areas of Investigation

Artificial Satellites

- Science
 - ◆ Reference Frame (GM, Earth CoM)
 - ◆ Earth Orientation Parameters (EOP)
 - ◆ Gravity Field (static and time varying)
 - ◆ Tides
 - ◆ Station position/motion and deformation
 - ◆ Gravitational physics tests, relativity
 - ◆ Atmospheric density
 - ◆ Time transfer
- Orbit
 - ◆ Improved orbit modeling
 - ◆ Mission-specific POD
 - ◆ Calibration/validation of altimetry
- Engineering
 - ◆ Q/C of stations
 - ◆ Comparison with other techniques
 - ◆ Spacecraft models
 - ◆ Refraction models



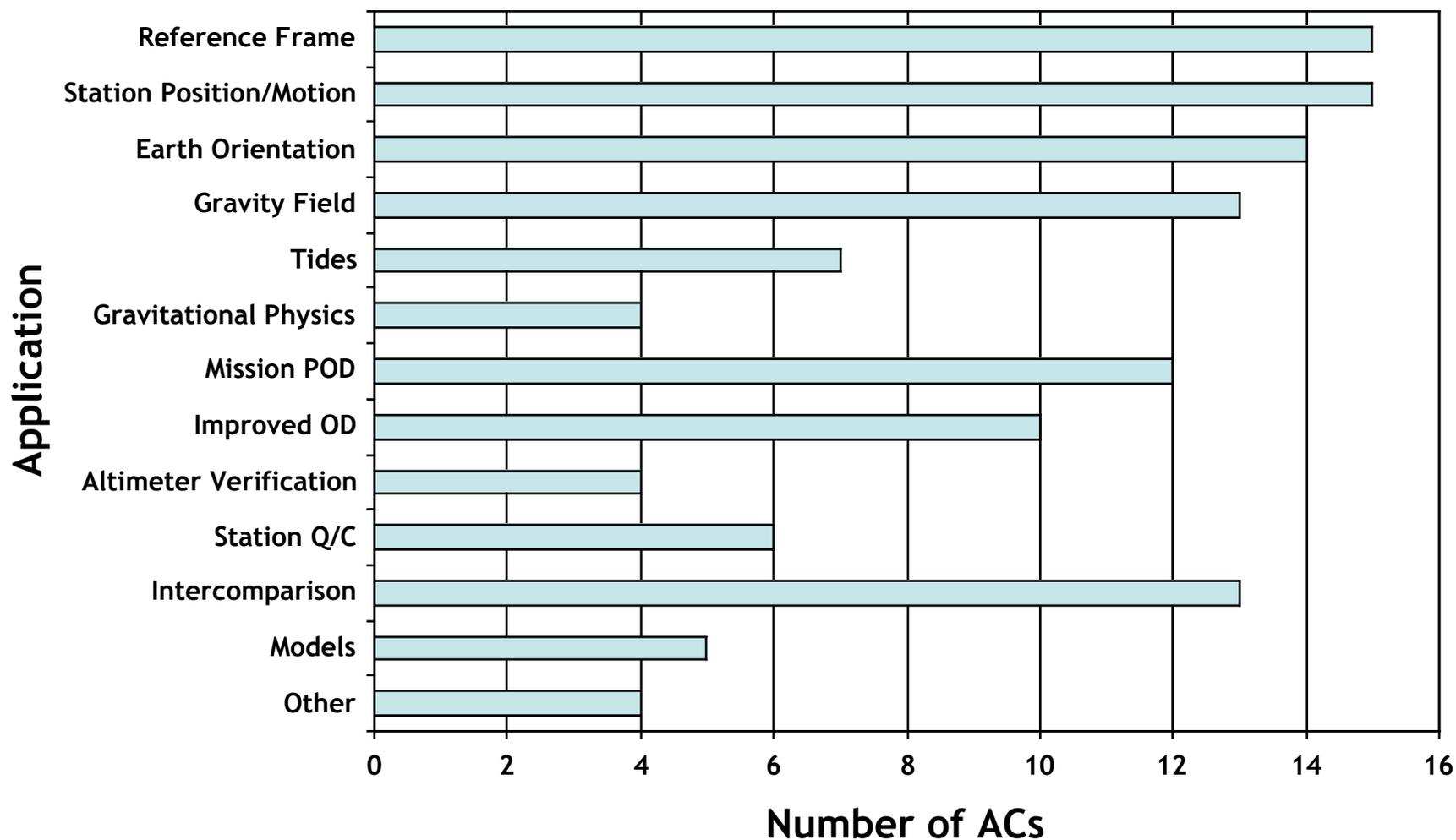
Areas of Investigation

Lunar Reflectors

- Lunar rotation
- Lunar composition, properties of core
- Lunar tides: Love numbers and tidal Q_s
- Precise solar system ephemerides
- Excitation of free librations
- Lunar reference frame and reflector positions
- Lunar moments of inertial and gravitational harmonics
- Gravitational physics tests: relativity, equivalence principle, dG/dt
- Astronomical constants: obliquity, GM (Earth+moon)
- Tidal dissipation

Areas of Investigation

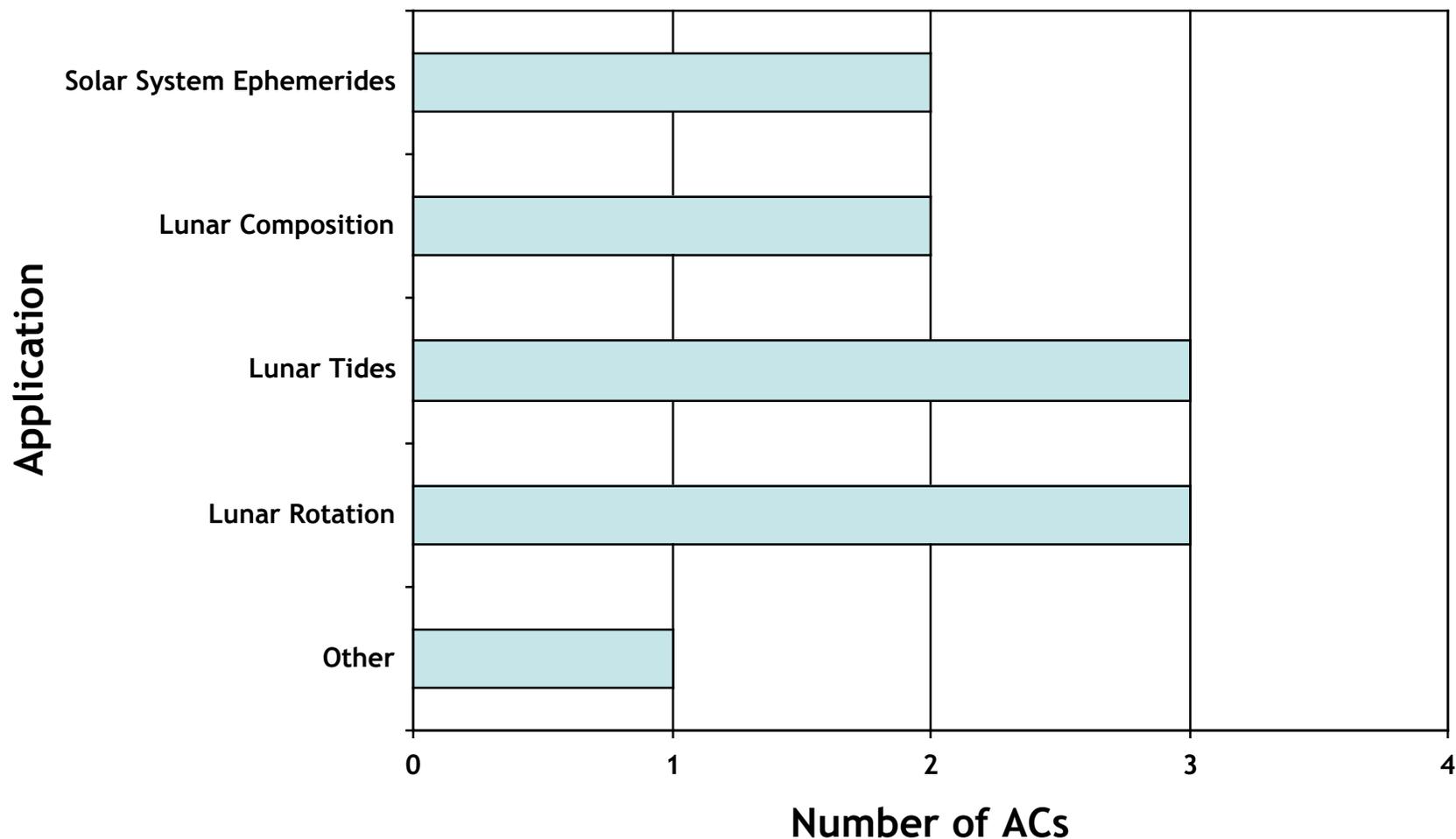
Artificial Satellites



Other includes atmospheric density, global deformations of Earth's crust, time evolution of EOP, relativity.

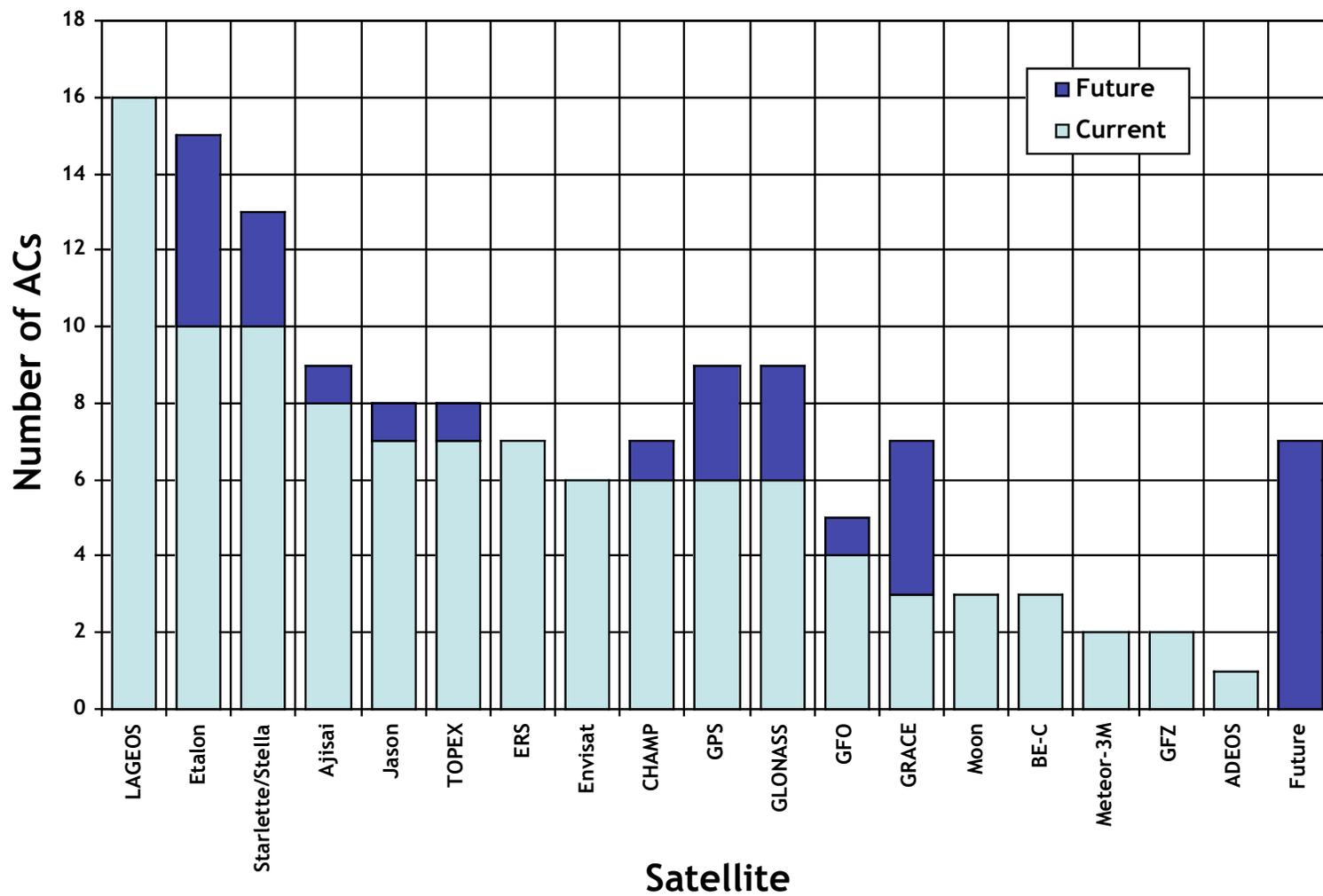
Areas of Investigation

Lunar Reflectors



Other includes lunar reference frame and reflector positions, lunar moments of inertial and gravitational harmonics, gravitational physics tests, astronomical constants, tidal dissipation

Satellite Usage



Questionnaire Responses

(SLR)

- Data volume
 - ◆ Generally, sufficient data (but could always be larger)
 - ◆ Dependent on satellite and region
 - ◆ Adequate LAGEOS
 - ◆ Need more tracking on Jason-1, GRACE, Etalon
 - ◆ Too much ERS tracking
 - ◆ Data volume sufficient for long-term analysis but not for short-term resolution of EOP
- Data coverage
 - ◆ Generally, sufficient (but could always be better)
 - ◆ Need more SLR stations colocated with VLBI
 - ◆ Pacific and Southern Hemisphere coverage not sufficient; more data from Arequipa; more data from inland areas (e.g., Maidanak)
 - ◆ Use mobile systems to increase coverage

Other Questionnaire Responses

(SLR, continued)

- Data accuracy
 - ◆ Generally, sufficient (but could always be better)
 - ◆ Quality of data from core stations is sufficient; other stations are downweighted
- New requirements
 - ◆ Site coordinates (in ITRF2000) and eccentricities need to be updated and distributed
 - ◆ Accurate site ties to VLBI and/or GPS
 - ◆ Regular submission of SINEX files by Acs (more complete info)
 - ◆ Access to historical info on range and timing bias by station
 - ◆ Better data distribution in space and time
 - ◆ Special issues of scientific journals on SLR (e.g., JGR, etc.)
- Data access
 - ◆ Access through CDDIS or EDC works fine
 - ◆ DCs should use same directory structure and post data with same file naming conventions



Other Questionnaire Responses

(SLR, continued)

- Suggestions and comments
 - ◆ Generate summaries of logfiles on a daily basis
 - ◆ Edited NPT data
 - ◆ CoM correction information and instruction on use
 - ◆ Modify NPT format to accommodate CoM, station parameters
 - ◆ Consistent file naming through the years
 - ◆ Create yearly NPT data files
 - ◆ Proper SINEX formats from ACs
 - ◆ Clarify corrected data in data files vs. use of data corrections file
 - ◆ Faster data delivery to data centers/users
 - ◆ Don't modify SLR format unless VERY necessary
 - ◆ Create new working group on use of mobile systems
 - ◆ Identify SLR R&D issues of the future
 - ◆ New applications of SLR for calibration of time transfer from Earth to space
 - ◆ ILRS is doing a good job!



Questionnaire Responses

(LLR)

- Data volume
 - ◆ Insufficient data on small lunar reflectors
- Data coverage
 - ◆ Insufficient LLR data and from small lunar reflectors in particular
 - ◆ Need more LLR-capable stations in the southern hemisphere
- Suggestions and comments
 - ◆ Push LLR as well as SLR analysis