Military Space and Public Transparency

Independent Analysis of Space Activities

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History of independent analysis

- Kettering Group, 1960s:
  - School children located secret Plesetsk launch site by Doppler tracking of satellites using short wave radio
  - Telemetry analysis identified navigation system

- Canadian Space Society, 1980s-1990s:
  - Amateurs with binoculars determined orbits of US military satellites
  - US refused to confirm sat deployed from STS-28 but was almost as bright as Saturn!
Geoff Perry and the Kettering Group
Vostok cosmonaut pulse data

- 0.15 sec heartbeat "off" pulse
- pulse rate
The Russian Military Space Station

- Sven Grahn in 1974
The Russian Military Space Station

- ALMAZ (left)
  - Military
  - Low orbit
  - No pictures
  - Telemetry (like recon)

- DOS (right)
  - Civilian
  - High orbit
  - Press coverage
  - Telemetry (like Soyuz)
Optical tracking

- Easy to track low earth orbit payloads!
Orbit analysis

- Modern personal computer is much more powerful that USAF computers of 1960s-1970s!
What we can learn

- Basic orbit shape: constrains possible missions
- Detailed orbital data: gives groundtrack, local times, etc.; reconstruct maneuvers and mission profile
- Mission-related objects: further inference on mission profile (e.g., discarded maneuver engines, despin weights)
- Launch vehicle: easy to figure out approximate capacity (e.g., Titan 4 triplets in 1990+, predicted existence of secret SLDCOM payload from missing weight)
- From orbit changes, infer propulsion system; or if propulsion system known, derive weights.
- Synthesize with public information and compare with previous missions
Ron Dantowitz and amateur satellite imaging
Satellite imaging
Satellite imaging – 2
Space Weapon Testing: The R-36O
Kosmos-139, January 1967

- R-36-O with OGCh payload
- Called FOBS (Fractional Orbital Bombardment System) in USA
- One orbit of Earth
- Retrofire: 2 minutes from orbit to impact
- Archival orbital elements for analysis
Comparison Atlas ICBM trajectory

- Purple line is typical ICBM trajectory
- Apogee around 1000-2000 km
- Perigee around 5000-4000 km below Earth surface.
- Less energy required
Suborbital firing to Kura, Feb 1966

- Perigee is around 700 km below surface?
- Much shallower than usual suborbital flights
- Second stage falls in Pacific
- Retrorocket slams warhead down into atmosphere
- Kura is standard Russian target point, like Kwajalein for USA
Suborbital firing to Pacific, May 1968

- Perigee is around 0 to 250 km below surface?
- This is nearly in orbit!
- Reconstruction from information that impact was 'near equator'
- Assumed same inclination as K-139
Secrecy implications of independent analysis

- Waste of energy to deny or conceal some activities
- If amateurs can do it, so can other governments
- Space activities are
  - Observable from many places on Earth
  - Highly constrained by simple physics
  - Therefore, difficult to conceal on a large scale
Security advantages of independent analysis

- In Europe and America, independent groups may have more credibility than politicians' statements.
- Public ignorance: many fear worst, assume space already weaponized! Need trustworthy (independent) assessment.
- Independent analysts provide credible, unbiased evidence on extent of treaty compliance.
- Less public pressure for arms race.
What we know

- Analysed 28200 space objects
- Very few are mysterious
- NO plausible candidates for secret space weapons systems- conclude none are yet deployed
- Openness about non-weapon military space systems makes it easier to verify absence of weapons – reduces tensions.
Analysis methods

• Patterns – easy for large constellations or frequently used launch vehicles
• Orbital mechanics and rocket physics – infer space vehicle properties from orbit changes
• Piece together different evidence – public statements, physical data, known capabilities
• What we miss: small secret payloads sharing space on host sat (e.g. GRAB satellite 1960-1962)
Data Sources

- Press statements
- Published technical papers
- UN Registration Data
- Space Command unclassified orbit data (for now)
- Amateur optical and radio tracking
- Known latitude, longitude of launch sites
Analysis used is very simple:

- Keplerian orbits with 1\(^{\text{st}}\) order (J2) perturbations, drag ignored, spherical Earth
- Rocket equation \( dV = V \ln(\frac{m_1}{m_2}) \) and \( dm = \frac{Tt}{V} \)
- Approximate but fairly accurate Earth rotation model (ephemeris to sidereal time conversion)
- Statistical analysis and data mining to sift through 5 Gbyte of data
- PLUS – 25 years of learning every satellite in orbit!