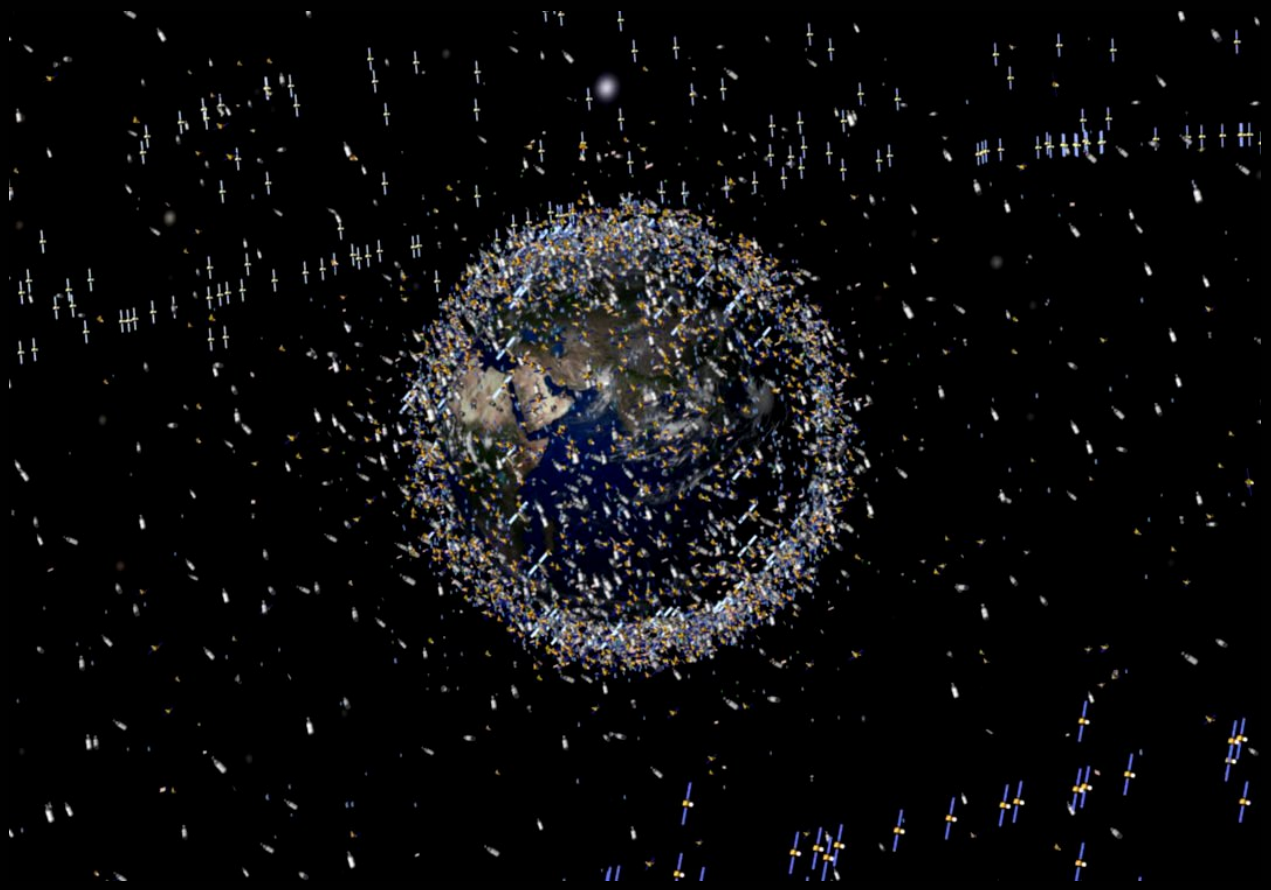
THE IRIDIUM 33 – COSMOS 2251 COLLISION

Creating Liability Awareness for Space Property

Contemplating the Future of Space Surveillance



A Research Paper by Michael A. Earl

Canadian Satellite Tracking and Orbit Research

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A special thanks to everyone diligently working in the Space Surveillance Network, the 1st Space Command Squadron, the Joint Space Operations Center, North American Air Defense and all others doing their best to keep the satellite population safe.

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INTRODUCTION

The recent collision between Iridium 33 and Cosmos 2251 has shed some doubt on the space surveillance community's ability to predict and/or report potential collisions between satellites currently orbiting the Earth.

Press releases issued by the parties directly involved have been especially informative as to the current ability of space surveillance institutions to effectively warn the satellite industry of impending collisions. In some cases, these press releases have suggested who might be liable for the collision.

Before attempting to determine responsibility, liability and fault for satellite collisions, specific collision scenarios should first be defined.

The satellite industry could spearhead research and development into a private satellite tracking infrastructure that could be used for studying tracking inactive payloads, satellite conjunctions and, most importantly, conjunction reporting.

Canadian Satellite Tracking and Orbit Research (CASTOR) has designed and implemented its own research project to determine the number of satellites that can be optically detected using retail telescopes and CCD cameras. CASTOR has successfully detected over 2,500 individual satellites from all orbit types, including most of the fully intact payloads such as (pre-collision) Iridium 33 and Cosmos 2251.

Throughout this paper, unless otherwise noted, the term "NORAD" will be used to represent U.S. space surveillance.

This paper is based on the author's experience since May 1997 with respect to optical satellite tracking as well as his direct experience with the American space surveillance community. This paper does not accuse any of the parties mentioned herein of any wrongdoing with respect to the Iridium 33 – Cosmos 2251 collision. This paper does not presume to know the intricacies of space law or any internal legal matters with respect to any member of the satellite industry.

ABOUT CASTOR

Canadian Satellite Tracking and Orbit Research (CASTOR) is a private business specifically created to research the feasibility of using optical satellite tracking facilities to detect and track orbiting satellites for the private sector.

CASTOR is based on expertise gained from 12 years of practical optical satellite tracking experience, including the design, construction, testing and operation of remotely controlled and automated optical satellite tracking facilities.

CASTOR has been detecting satellites from all orbit types (LEO, MEO, GEO and HEO) since January 1, 2007. At the present time, CASTOR has successfully detected and catalogued over 2,500 unique satellites, consisting of 1,142 Low-Earth Orbiting (LEO) satellites, 745 Mid-Earth Orbiting (MEO) satellites, 586 Geosynchronous (GEO) satellites and 21 High-Earth Orbit (HEO) satellites.[46]

CASTOR's services currently include:

1) Routine tracking of inactive payloads and spent rocket stages,

2) Emergency optical satellite tracking for payloads that suddenly become inactive and cannot be tracked with TT&C facilities,

3) Professional consulting for the design, construction, testing and operation of an optical satellite tracking facility,

4) Developing useful strategies for conjunction analysis and reporting.

The images and tracking data that CASTOR has collected has been used to develop a separate catalogue from NORAD's. The CASTOR Satellite Catalogue (CSC) contains satellites that can be detected with commercial off the shelf telescopes and CCD cameras.

CASTOR is currently pioneering the development of the emerging science of satellite tracking for the remainder of the 21st century and beyond.

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GLOSSARY OF ABBREVIATED TERMS

1SPCS:	1st Space Command Squadron
α:	Right Ascension
δ:	Declination
CASTOR:	Canadian Satellite Tracking and Orbit Research
CCD:	Charge Coupled Device
CSC:	CASTOR Satellite Catalogue
Dec.:	Declination
DoD:	(American) Department of Defense
E:	East (Azimuth 90 degrees)
EOL:	End of Life
GEO:	Geosynchronous
GEODSS:	Ground Based Electro-Optical Deep Space Surveillance
GPS:	Global Positioning System
HEO:	High Earth Orbit
J2000.0:	Julian Epoch 2000.0
km:	kilometers
LEO:	Low Earth Orbit
LLC:	Limited Liability Company
MEO:	Mid (Medium) Earth Orbit
N:	North (Azimuth 0 degrees)
NORAD:	North American Air Defense

R & D:	Research and Development
R.A.:	Right Ascension
RF:	Radio Frequency
sec:	seconds
TLE:	Two Line Element
TT&C:	Telemetry, Tracking and Control
UCT:	Un-correlated Target
UN:	United Nations
U.S.:	United States
U.S.A.:	United States of America
USNO:	United States Naval Observatory
U.S.S.R.:	Union of Soviet Socialist Republics
UTC:	Universal Time Coordinate