

Pandemics and Disasters

ONTOLOGY SUMMIT 2022

1

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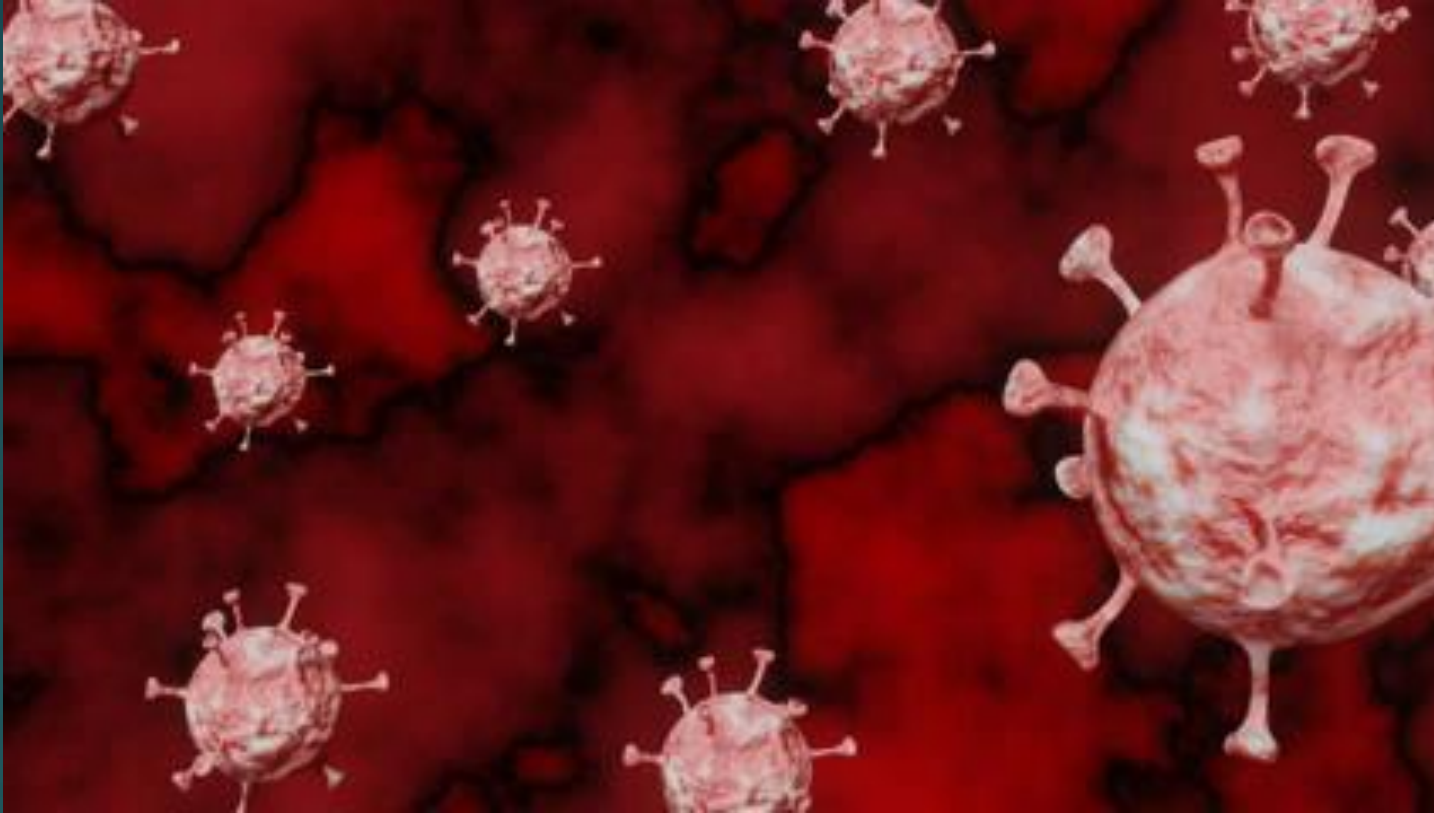
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1

1

Sights and Sounds of Disasters

2



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Sounds of Disasters from YouTube

3

- ▶ From YouTube (Credits)
- ▶ <https://www.youtube.com/watch?v=NgkTdIECYtk>

Selected Disasters for Ontology Summit 2022

4

Overviews:

- Examples - CYC Architecture and Applications, Situational Awareness,

Track 1: Disaster Landscape

- Examples - Parametrics, Knowledge Graphs, Rules, Metadata, Metrics

Track 2: Pandemics

Track 3: Environment Disasters

Track 4: Aerospace/Maritime Disasters

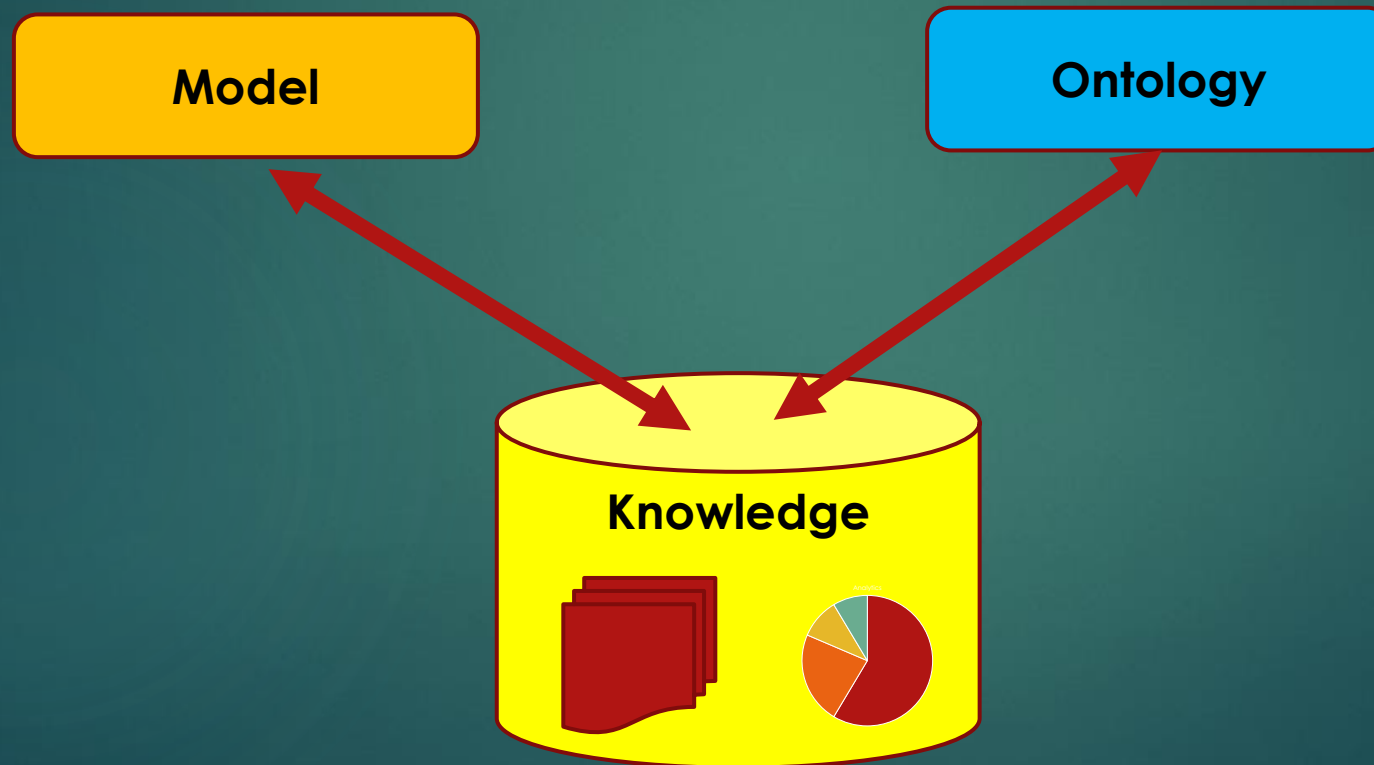
Disaster Landscape

SCIENCE- MODELS, KNOWLEDGE REPRESENTATIONS, ONTOLOGIES
ARE COMPLEMENTARY ROLES
AS OBSERVED DATA AND THEORY HAVE TO MATCH!

Overview

6

- ▶ Disaster Phenomenon
- ▶ Model and Ontology are ideally based on same knowledge



ARE SCIENTIFIC MODELS AND ONTOLOGIES DIFFERENT?

▶ SCIENTIFIC MODELS (EXAMPLE)

- ▶ CONCEPTS
- ▶ LOGIC
- ▶ PARAMETERS
- ▶ VALIDITY RANGE
- ▶ OUT OF SCOPE
- ▶ ACCEPTED MODELS CAPTURE
 - ▶ PROCESS
 - ▶ PHENOMENA
 - ▶ ALGORITHMS - FORMULAE
- ▶ ABLE TO EXPLAIN DATA
- ▶ EXTENSIONS (VALIDITY)

▶ ONTOLOGIES

- ▶ ENTITIES – RELATIONS (E-R)
- ▶ TYPES, STRENGTHS AND UNCERTAINTIES IN (R)
- ▶ DATABASES
 - ▶ CONCEPTUAL , LOGICAL AND IMPLEMENTED
- ▶ KR'S, KB'S, KMS
- ▶ SEMANTICS – Gary's graph
 - ▶ THESAURI,TERMS,VOCABULARIES
- ▶ Ontology depictions
 - ▶ ML, AI, KNOWLEDGE GRAPHS
- ▶ Ken Baclawski's pathbreaking KGSQ

ONE TRUTH WITH DIFFERENT VIEWS

8

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- ▶ IF MODEL AND PHENOMENA ARE CLOSER
 - ▶ ONTOLOGY IS EMBEDDED IN MODEL
 - ▶ COMPLEXITY IS IN ABILITY TO REVEAL THE ONTOLOGY
 - ▶ KNOWLEDGE GRAPHS PROMISE TO CAPTURE MODELS AND ONTOLOGIES
 - ▶ EXAMPLE: CORE AND EXTENSIONS
 - ▶ CORE IS GENERAL THEORY OF RELATIVITY
 - ▶ EXTENSIONS HAVE EXPLAINED DIFFICULT BUT DISCOVERIES HENCE; SUCH AS GRAVITATIONAL WAVES, COSMIC MICROWAVE BACKGROUND, POTENTIAL UNIFICATION DIRECTIONS
 - ▶ STANDARD MODEL: VALIDITY QUESTIONED FOR HIGGS, DARK MATTER, ORIGIN OF UNIVERSE
- ▶ IF MODEL IS GOOD EMBEDDED ONTOLOGY IS PROBABLY CORRECT
- ▶ IF ONTOLOGY IS DESIGNED WITHOUT UNDERSTANDING OR CORRECT MODEL, IT MAY NOT NECESSARILY BE CORRECT!

PARAMETRICS

9

- ▶ FILTERS FOR IMPACT / RISK REDUCTION
 - ▶ GEOSPATIAL EXTENT (SCALE)
 - ▶ GLOBAL, REGIONAL, LOCAL
 - ▶ AND POPULATION DENSITY
 - ▶ URBAN, SEMI AND RURAL
 - ▶ COASTAL - TSUNAMI
 - ▶ ECONOMIC IMPACT – CONTINUING OPERATIONAL INVESTMENTS ESSENTIAL
 - ▶ SOVEREIGN
 - ▶ INFRA, UTIL, HABITAT, RECONSTRUCTION, Coast. River, Land Atmosphere
 - ▶ COMPOUND – HURRICANE FOLLOWED BY FLOODS
 - ▶ TEMPORAL (FREQUENCY) CONTINUITY ESSENTIAL FOR CHANGE DETECTION
 - ▶ (TORNADO BELT, DESERTIFICATION, DEFORESTATION)
 - ▶ REGULATIONS, LACK OF AGREEMENTS (SPACE DEBRIS)

Knowledge – Earth Science examples

10

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Oceans & atmospheres

- ▶ Science of ocean atmosphere interaction developed
- ▶ Careful partitioning can generate sub-domain ontologies
- ▶ Knowledge use for Risk Management, Recovery, resilience (Dikes), etc.
- ▶ Complex changes – difficult to model natural environment factors combined with human caused impacts

Solid earth

- ▶ Seismic, volcanic, landslides, less coupled or understood
- ▶ Short term- Earthquake
- ▶ Long term- desertification
- ▶ Difficult challenges
 - ▶ Nuclear waste management
 - ▶ Plastics in oceans
 - ▶ Chemicals in water and air
 - ▶ Erosion and land recovery

50 Years Experience

- Earth Observation Systems - Data and Information Systems Dozens of papers and reports

- ▶ 1968-72 NASA HQ
- ▶ Apollo Space cryogen and water dumps
- ▶ ERTS / Landsat Spectral Band Selection, Radiative transfer for Atmospheric Corrections
- ▶ Skylab Multispectral Scanner and IR Spectrometer Experiments. Oversight
- ▶ Space Shuttle Sorties for Day / Night Earth viewings (PI) NASA HQ
- ▶ 1973-79 India's Satellite Bhaskara Concept to implementation and establishing national remote sensing agency and IRS and INSAT (Met) satellites
- ▶ 1996-2000 NASA GSFC on Terra, Aqua, Chem, Polar Satellites And Data and Info Systems, Image data, NASA Petabyte Active Archives
- ▶ Constellations with radiation ATMOSPHERIC data records / NOAA
- ▶ FGDC Metadata, with vocabularies

Remediation

12

- ▶ Direct costs: expenditure on R&D, Manufacture of Vaccines, formulations, supplies and hospitals and health facilities
- ▶ Indirect costs: human lives(?), human health effects, non health related
- ▶ Productivity Products and Services impact costs
- ▶ Symbiotics, work-force and supply chain, related prices, inflation etc.
- ▶ Reuse of knowledge, filtered for residual applicability, to reduce development times
- ▶ Advances in technologies, innovation and cost reductions as well as rapid development
- ▶ Survival instinct depending on crying need and available resources.

Progress and Challenges

13

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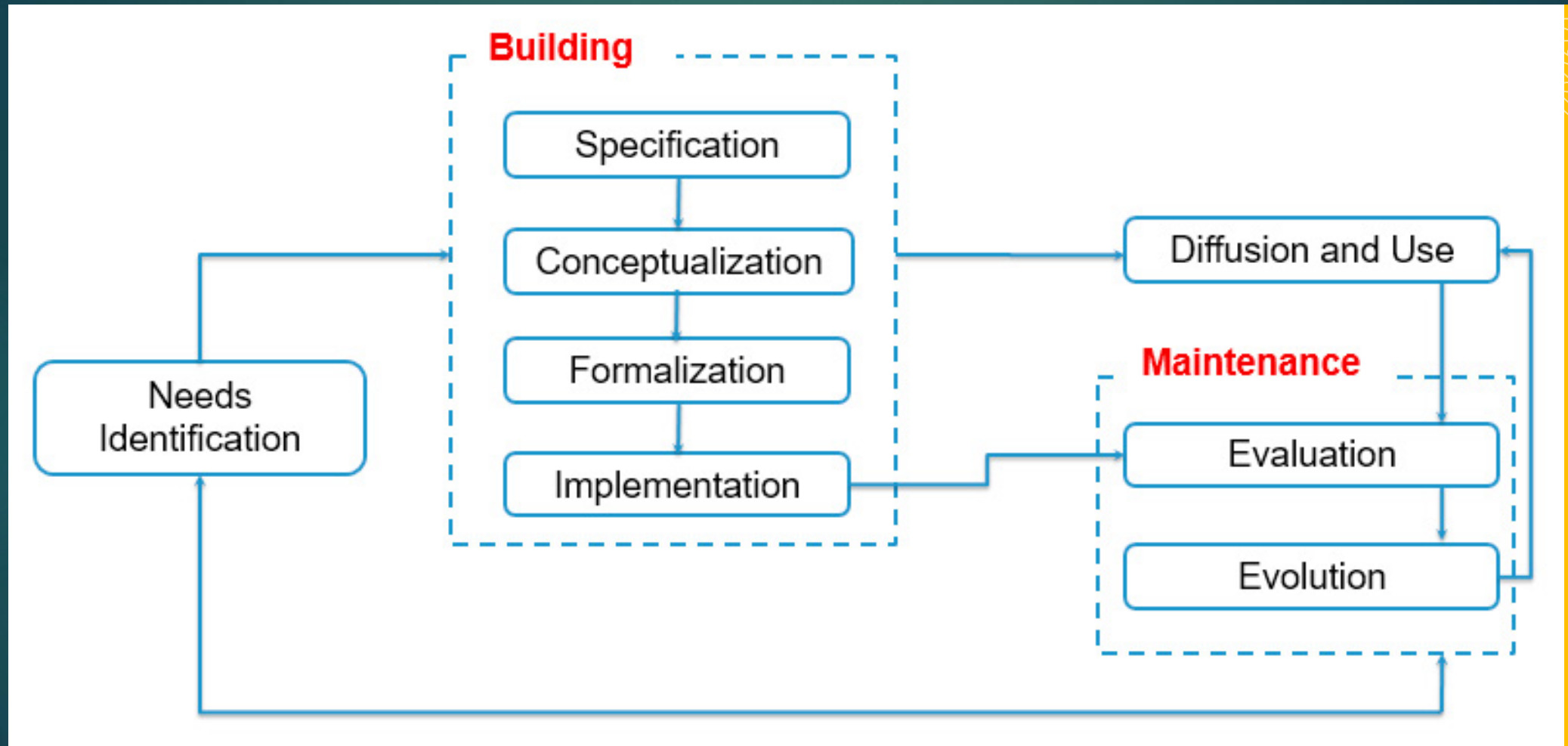
- ▶ If sub-models such as precipitation and forest cover are correct, then sub-domain ontologies are likely correct.
- ▶ Can not neglect science (Physics and Chemistry) when constructing ontologies
- ▶ For ML and AI underlying ontologies have to be consistent with models. **Complementary Roles of Rules (Science) and Ontologies**

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- ▶ Often Counterproductive efforts – economic, political reasons (vaccines)
 - ▶ Resource sharing hesitancy – international boundaries (river waters)
 - ▶ Migration, widening economic disparities vs political systems
 - ▶ Costs and impacts of potential accidents and runaways – pandemic, viral, chemical, radio and other human caused.

Pandemics Ontology Example (Ref 1)

The ontology lifecycle

14



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Tools used in Ref 1.

15

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- ▶ **Protégé Desktop**
- ▶ **Snap-SPARQL Query Plugin**
- ▶ **DL Query Tab**
- ▶ **Reasoners**
- ▶ **OOPS**
- ▶ **AllegroGraph**

Covid-19 Ontologies examples (Ref 1.)

16

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- ▶ [34] The COVID-19 Surveillance Ontology Demographic details, key clinical features, relevant comorbidities, risk factors and mortality. SNOMED CT Protégé, OWL.
- ▶ Various use-case domains of the RCGP RSC. External validation using a rapid Delphi consensus exercise Surveillance activities of the COVID-19 pandemic.
- ▶ [36] CODO COVID-19 Cases and patients information, relations, geographic locations, and date-time information. SNOMED CT FOAF OWL DL Protégé, the pellet reasoner, SWRLTab, Cellfie, snap SPARQL, AllegroGraph and Allegro's Gruff.
- ▶ Importing data on the pandemic from the government of India. Querying the ontology. Storing the ontology in a commercial triple store. Using this ontology by data and services to model and annotate the COVID- 19 information.
- ▶ Developing and offering distributed, heterogeneous, semantic services and applications

Reference 1

17

Leila Bayoudhi, Najla Sassi, Wassim Jaziri,

An Overview of Biomedical Ontologies for Pandemics and Infectious Diseases Representation,

Procedia Computer Science, Volume 192, 2021, Pages 4249-4258, ISSN 1877-0509,

<https://doi.org/10.1016/j.procs.2021.09.201>.

(<https://www.sciencedirect.com/science/article/pii/S1877050921019402>)

Abstract: Several infectious diseases and pandemics have so far emerged. Pandemics are by nature rapidly evolving. In this context, COVID-19 cases, seen recently in a growing number of countries around the world, have been increasing exponentially. So, researchers and responsible actors should take quick decisions to mitigate the spread of such diseases. To do so, several computer science solutions, including ontologies, have been proposed to cope with these issues and save humanity. The ontology is the key formalism which allows modelling knowledge along with its semantics in a formal way. Indeed, the ontology provides unambiguous definitions of a discourse's domain terms in a machine understandable way. Particularly, biomedical ontologies have ever been developed to capture and represent pandemics and infectious diseases. In this context, this paper aims to scrutinize and study these state-of-the-art ontologies.

Keywords: Pandemics; Infectious diseases; Biomedical; Ontology; Representation

Aerospace Maritime disasters

18

- ▶ Important factors
- ▶ Situational Awareness
- ▶ Regulatory bodies and Agreements
- ▶ Cost and availabilities of remedies
- ▶ Transponders needed on all aircraft to create situational awareness and satellites to provide traffic movement information, Aircraft self service autonomous capabilities
- ▶ Air traffic and marine ports management systems with multimodal transports
- ▶ Experience of UN Outer Space Committee, JPDO (NextGen

Space Debris

19

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- ▶ LEO most problematic
- ▶ Eventually satellites for debris removal, ground based techniques.
- ▶ Every satellite with safe deorbiting capability. Kessler syndrome and ASAT regulations
- ▶ Algorithms for better cross (or nodal) potential impact determinations
- ▶ Low atmosphere concentrated air-traffic management and awareness in coexisting air taxis, aircraft, drone and space Launch vehicles (defense and civilian traffics)
- ▶ Worked on Particle contamination, Dumps, interstellar grains, seismic impacts from Saturn rockets on moon and analysis of data, Apollo 13 Anomaly LEM tracking
- ▶ Same NORAD and Baker Nunn telescopes being used for debris tracking.