Jotne interests in R&D

edf2025@jotne.com

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About Jotne

Jotne is a Norwegian SME software company, highly specialized in the Aeronautics, Space and Defense domain, providing interoperability solutions within Digital Twin, MBE, Simulation, PLM, IoT and more to manage all system data in engineering and operational phases. All software developed by Jotne is based on Open Standards like ISO TC184/SC4 and more specifically ISO 10303 for CAD/FEM/PLM/IoT and the foundation for AI/ML.

Jotne provides support to the most complex defence programs like F-35 and Eurofighter for the last 25 years and have running programs with the stakeholders like Lockheed Martin, Airbus, Leonardo and BAE Systems and European Space Agency (ESA).

Jotne started with EU R&D and EDA programs in 1991 and have currently several EU programs. In addition, we run 3 EDF projects, dTHOR, EDINAF, and SDMMS. We have strong relationships to academia and recently completed a PhD related to the Digital Twin topic.

Relevant background

EUROPEAN UNION
EUROPEAN DEFENCE FUND

EDINAF

dTHOR

SDMMS

esa

LOCKHEED MARTIN

AIRBUS

LEONARDO

BAE SYSTEMS

AEROJET ROCKETDYNE

VOLVO

Medtronic

ISO

BOSCH

KEY FACTORS

Sales
16,3 MEUR

Employees
85

Countries (customers)
Norway, Europe, US

CONTACT

helpdesk@jotne.com

www.jotneconnect.com

PDM since 1996
Eurofighter
Airbus
Leonardo
BAE Systems

Space since 2003
Today Digital Twin
Spacecraft

AIRBUS

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LOCKHEED MARTIN

STEP since 1999
SimDM (FEM)

F-35 FACO Since 2011
Crystal
Today REPLAY

Recent press release

Jotne and Lockheed Martin Expand Partnership to Drive Digital Engineering Transformation

USA - English

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NEWS PROVIDED BY
JOTNE CONNECT AS →
Dec 10, 2024, 06:23 ET

OSLO, Norway, Dec. 10, 2024 /PRNewswire/ -- Jotne, a leader in digital engineering solutions, proudly announces the expansion of its long-standing collaboration with Lockheed Martin to accelerate digital transformation across the Aeronautics, Space, and Defense sectors. This $1,900,000 contract is part of a multi-year program that integrates Jotne's advanced software solutions to streamline data exchange, reduce costly rework, and speed up aircraft development cycles.

Jotne's collaboration with Lockheed Martin Aeronautics focuses on enhancing a trusted, open-standards-based digital repository that supports product lifecycle data interoperability. By adopting Jotne's innovative technologies, Lockheed Martin aims to reduce the complexities and costs associated with managing Technical Data Packages (TDP), making product development more efficient and cost-effective.

Driving Innovation with ISO 10303-STEP Standards

At the heart of this partnership is the implementation of the ISO 10303-STEP standard, which enables seamless data exchange across different engineering, manufacturing, and supply chain management systems. This international standard ensures that data can be

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With the wish to create new knowledge

All started with an idea back in 1991 and resulted in an EU project “PRODEX” which ran from July 1992 through June 1995. Then the NATO NETMA and the Eurofighter GmbH team started to talk with us and still using our software in 2024, after 25+ years.

R&D projects has proven to be a good vehicle for joint efforts and to create new business opportunities.

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The Jotne Story

EUROPEAN UNION
EUROPEAN DEFENCE FUND

EUROPEAN RESEARCH & INNOVATION

1991
submitted
First EU
proposal

1996
First
Contract
with
Eurofighter

2003
First ESA
contract

esa

2007
EDA
Project

2012
F-35
Lockheed
Martin

2022
EDF Projects

1996
First
commercial
products

Milestones that built success

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Interoperability for Digital Twin, PLM, Simulation and Technical Data Packages, utilizing open standards

Jotne is a leading provider of advanced engineering software solutions for the Aerospace, Defence, and Space industries. The company's applications offer a comprehensive suite of tools for managing the entire product lifecycle, from concept design to product retirement and it help organizations optimize their product development processes and increase efficiency.

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Examples of leading organizations that trust the ISO 10303 (STEP) standards and the Jotne applications to support it

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LM Digital Twin Maturity Model

Level 1 – Virtual Digital Twins (DT)

Virtual Digital Twins – Prototype Modeling and Simulation

Do you have high fidelity or physics based digital twin models and simulations for :

- Configuration and Master Data
- Stealth
- Structural Performance
- MBSE Requirements and system interferences
- Vehicle Systems. Flt Controls, and SW
- Mission Systems and SW
- Operations Analysis
- Manufacturing/Production
- Supply Chain
- Sustainment, Reliability, Maintainability, Safety
- Affordability/Cost/Capital Req.

Does your Digital Twin predict mission success and compliance with customer requirements?

Did your models identify opportunities?

Level 2 – DT/PA Synchronization

Manual Virtual/Physical Synchronization of Digital Twins

- Is your DT representative of the physical asset?
- Did your DT baseline facilitate design trades and configuration optimization?
- Are your DT models manually updated for design and requirement changes?
- Does your digital twin represent the physical asset performance and design?
- Are your DTs manually updated with the latest test and field data?
- How well did your level 1 DT support the physical asset performance and configuration baseline ?
- Were major changes required after design start to address performance or requirements issues unidentified by the DT?
- Are your DTs resident in an integrated design environment?
- Do your DT simulations interact with hardware in the loop?
- Did your virtual PAVs identify opportunities for improvements?

Level 3 – DT/PA Validation

Automated or Continuous Virtual/Physical Synchronization and Validation of Digital Twins with Physical Assets

- Are your DT models routinely or automatedly synchronized to the latest configuration baseline?
- Do your DTs predict physical asset behavior?
- Are your DT models automatically updated to represent the latest test, field, or analysis data?
- Have your DTs predicted problems with the physical asset performance, design, field results, or requirements that require corrective action?
- Has validation or qualification or fielded results of the physical asset identified unexpected problems?
- Do your DTs support visualization capabilities in the simulation environments?

Level 4 – DT/PA Integration

Enterprise Integrated Product Digital Twin

- Do your DT simulations drive your hardware in the loop?
- Does your DT enable parts monitoring, forecasting and predictions from operational data?
- Do you have mature integrated DT models to support Operations Analysis, spiral development, and sustainment?
- Are your physical asset validations used to improve your DT development and sustainment tools in preparation for the next product development cycle?
- Does the DT accurately predict performance in the operational environment?
- Have your DTs eliminated some or most legacy physical testing and lab validation?
- Is the DT accredited as the Master Model of the Product that can be used for virtual customer validation of requirements?

Level 5 – DT Operational Ecosystem

Digital Twins Common Operational Simulation Eco-system

- Can your DT models be connected and integrated with other LM product DTs and with customer provided non LM assets in a common simulation environment?
- Do your DTs adequately predict actual performance and operations (including sustainment data) in the JADO environment?
- Will customers use simulation based performance and operations validation without requiring subsequent physical demonstrations?
- Is your DT development and testing used to upgrade your DT tools and processes?
- Do customers utilize integrated Digital twin effects as certification criteria?
- Did your models identify opportunities for improved performance in the simulation environment?
- Do your interoperable DT's predict the performance of coordinated mission effects across multiple domains (land, air, sea, space, cyber)?

DT/PA = Digital Twin/Physical Asset

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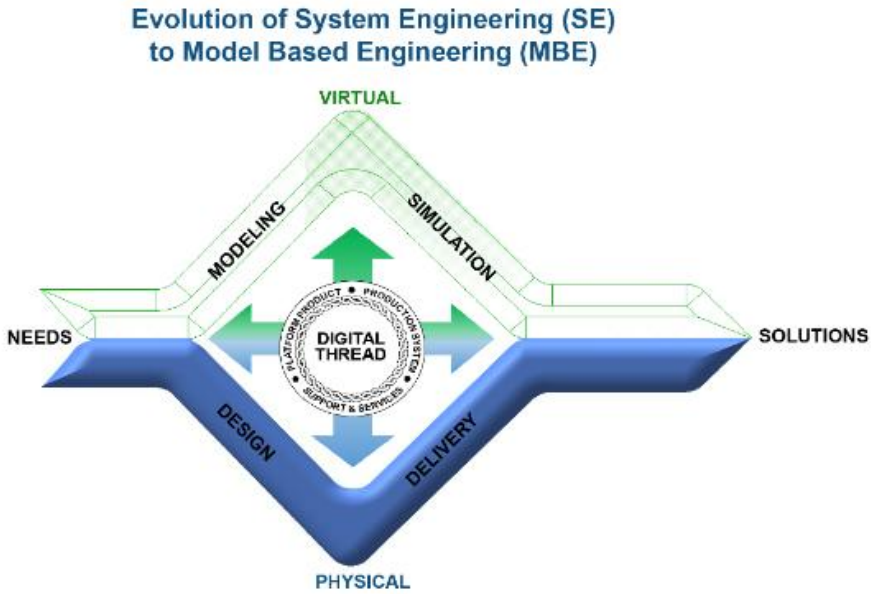
Standards

LOCKHEED MARTIN

This Lockheed Martin, MBE Playbook will have major impact on current and future projects, both in the supply chain, partnerships, and customers. Jotne as a supplier of ISO 10303-STEP software applications stand behind such strategy and is ready to support, promote and sustain these capabilities.

ISO

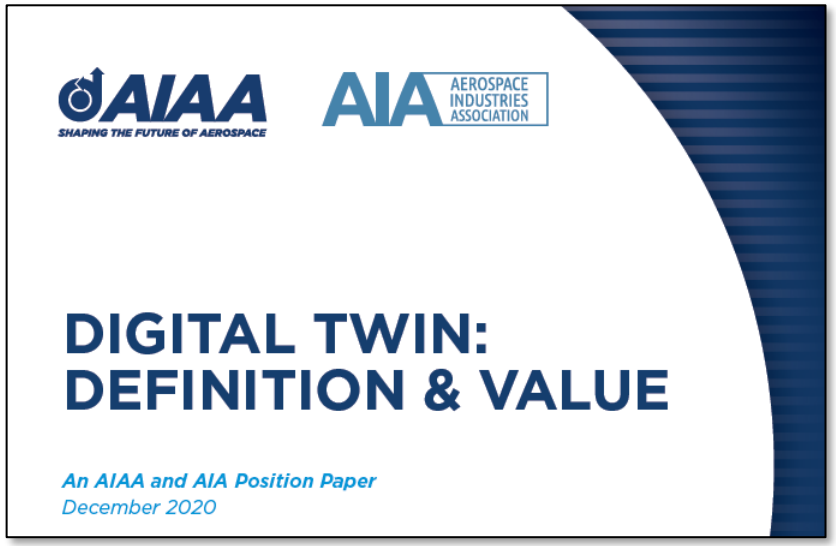
BOEING

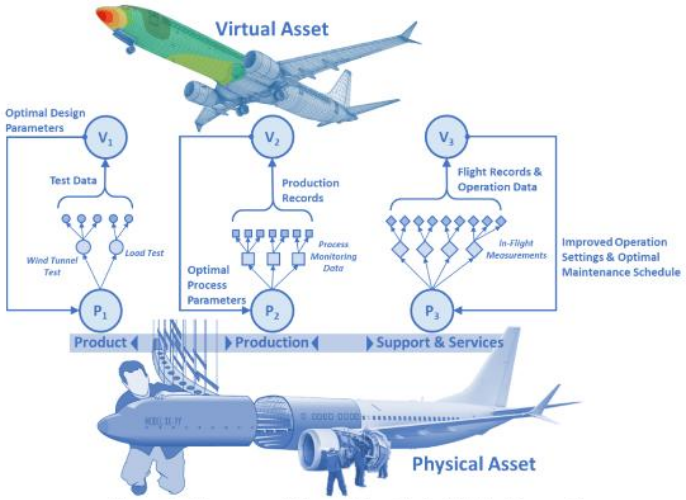


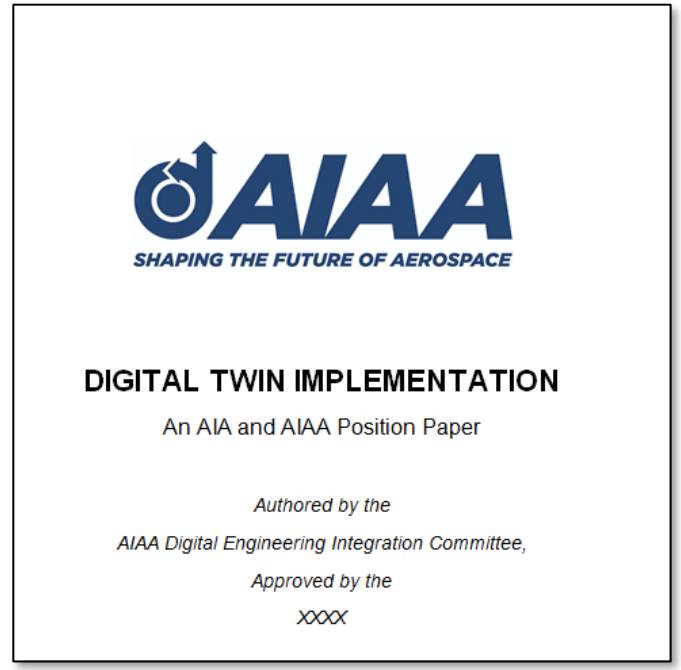
The digital thread is a linked set of artifacts whose consistency is actively managed over the life cycle of the product. The digital thread is an engineered digital system. As the design matures over time, the relationships of these models become the foundation for design re-use, cycle time reduction, and improved quality.

Both companies identify ISO 10303-AP 242 (STEP)

DT and its adoption by OEMS

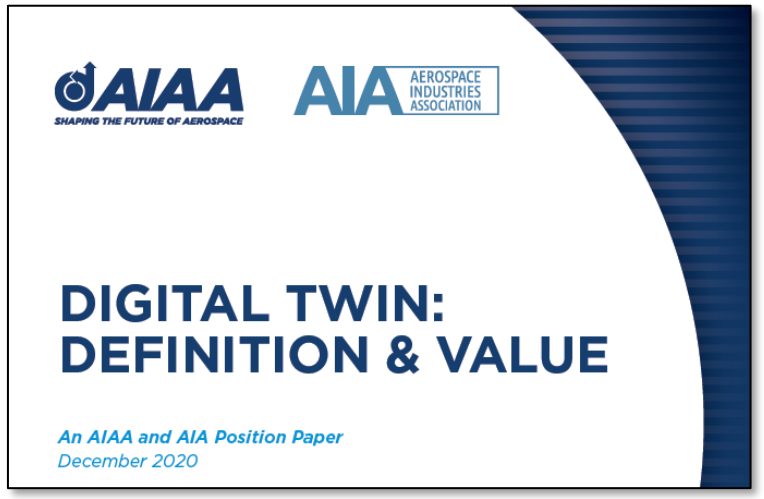






DT and its adoption by Aerospace OEMS

Standards



1. Need to develop appropriate standards and/or standard approaches so that Digital Twins can interact with other Digital Twins across the life cycle and supply chain.

2. Significant value and increased collaboration could be realized by establishing appropriate foundational open standards (e.g. data and models) and life cycle architecture frameworks.

3. Therefore, additional focus and effort should also be given to addressing which *elements of this foundation should be open*.

Jotne in European research and technology programs

HORIZON EUROPE

EUROPEAN UNION
EUROPEAN DEFENCE FUND

esa

ARROWHEAD TOOLS

KYKLOS 4.0

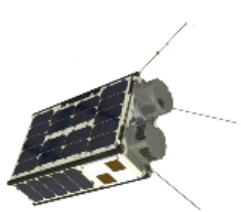
DAIS

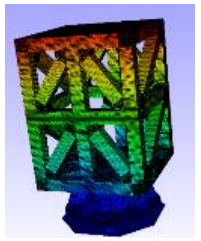
ABS EU

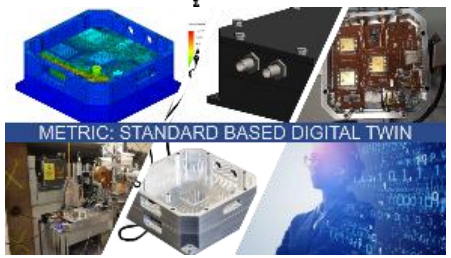
dTHOR
Digital Ship Structural Health Monitoring

SDMMS
Secure Digital Military Mobility System

EDINAF
European Digital Naval Foundation







TREEADS

manu net

Mine.io

CHANGE2TWIN

5G-TIMBER

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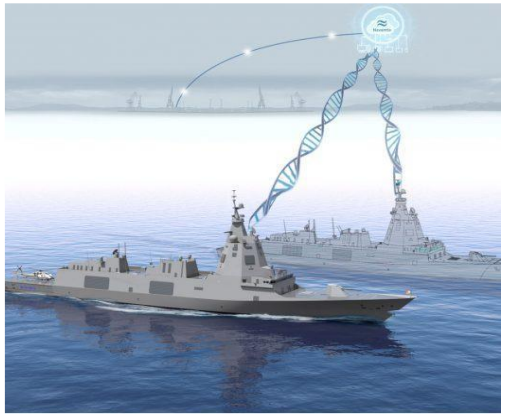
Jotne in EDF programs

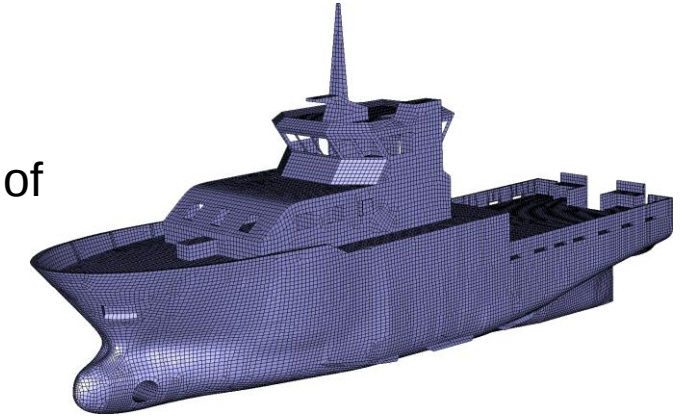


SDMMS will develop a secure digital information system in support of Military Mobility.

EUROPEAN UNION
EUROPEAN DEFENCE FUND

EDINAF will provide a European digital ship reference architecture, integrating the systems onboard altogether in order to achieve vessels fastest reaction and enhanced capabilities.

dTHOR will develop the next generation of a predictive Ship Structural Health Monitoring system.



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The Jotne Digital Twin Conference

dTHOR will consolidate end-users military operational requirements based on improved battle damage and structural integrity assessment, reduced hydro-acoustic signatures, and more accurate operation of weapon systems

Norwegian Partners

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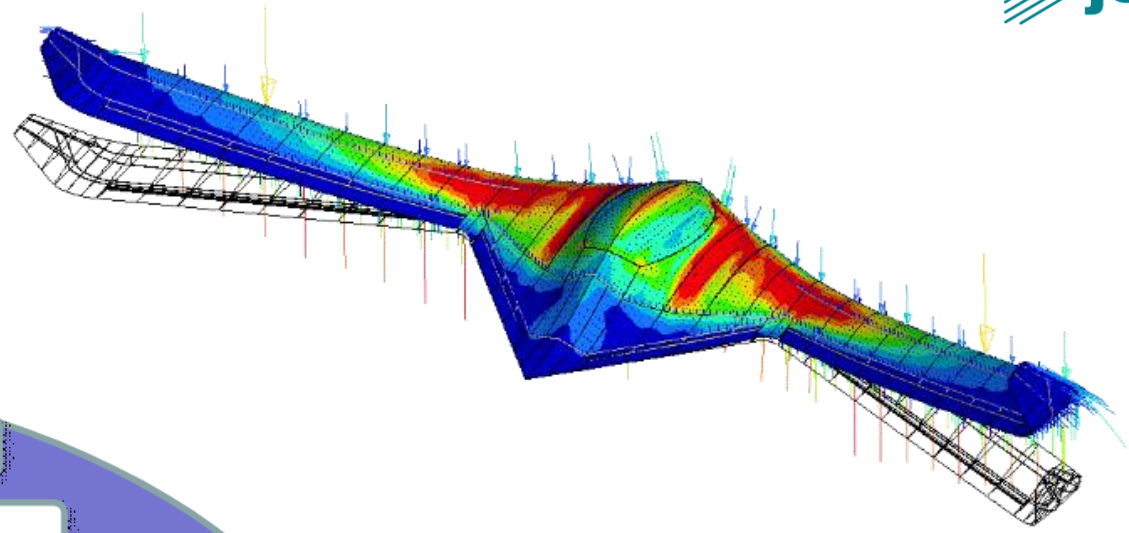
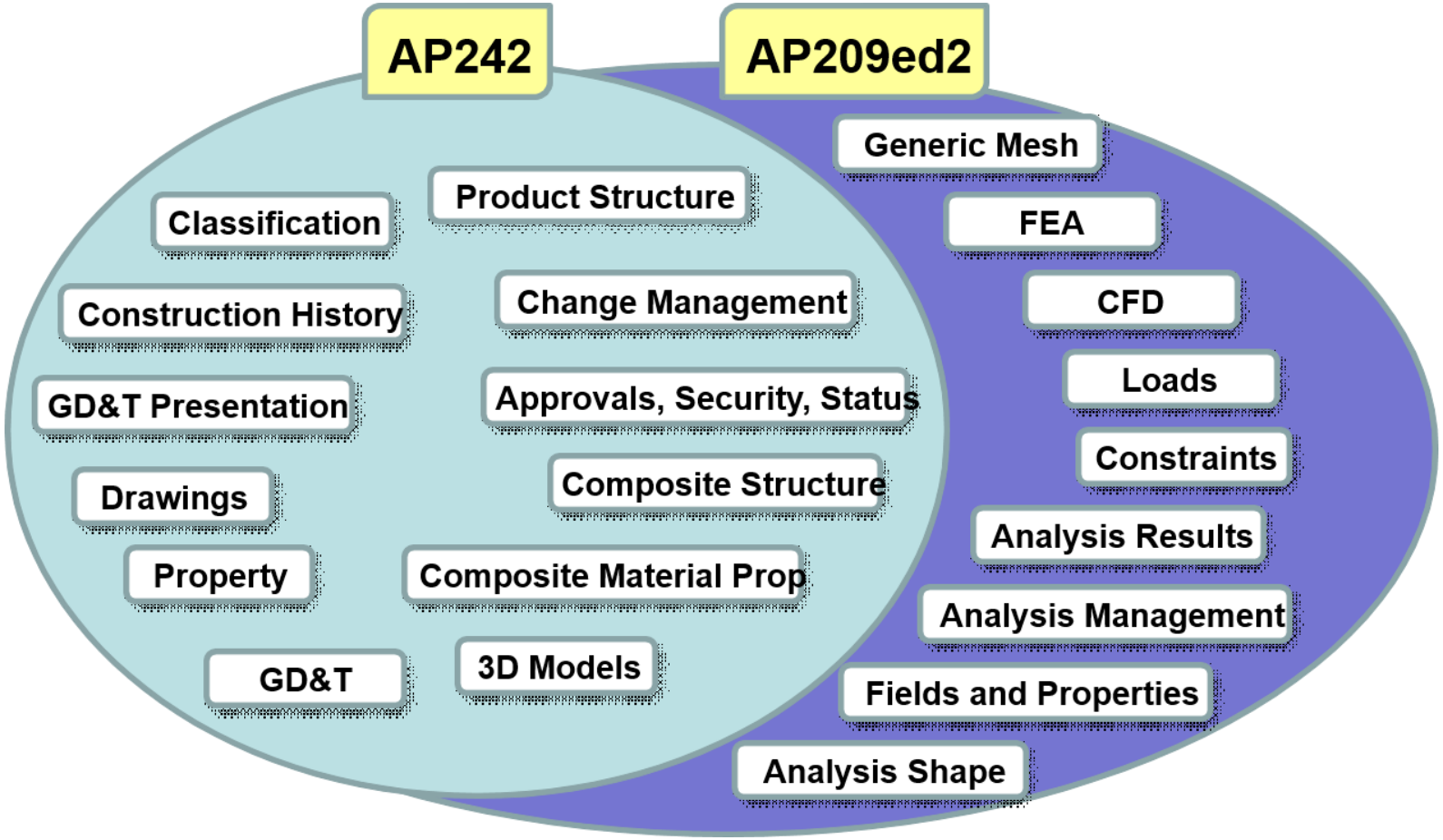
LIGHT STRUCTURES
Passion for Monitoring

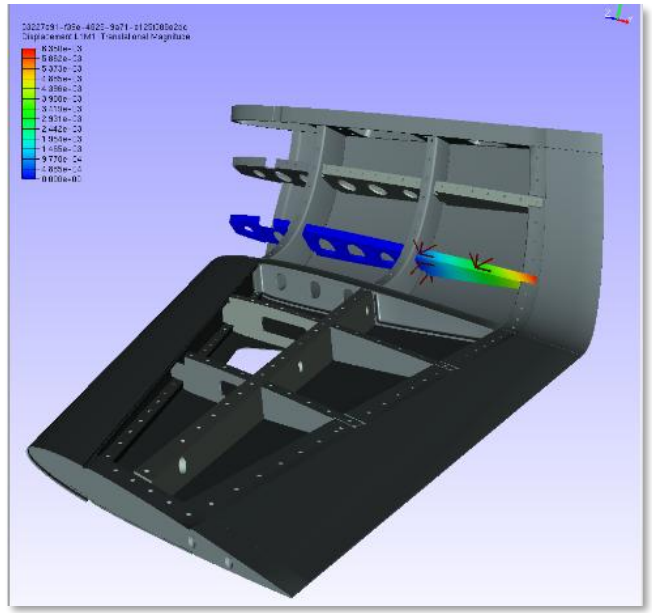
SINTEF

Program and presentations

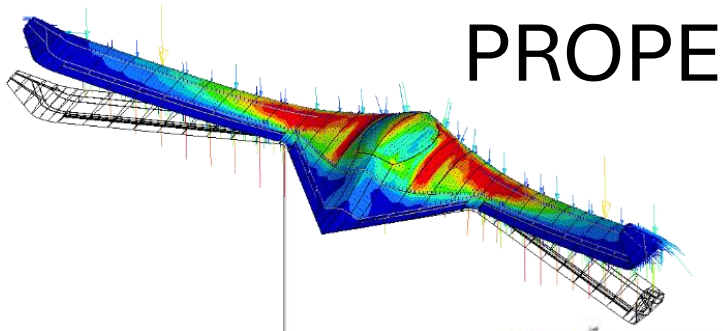
Content of ISO 10303-242/209

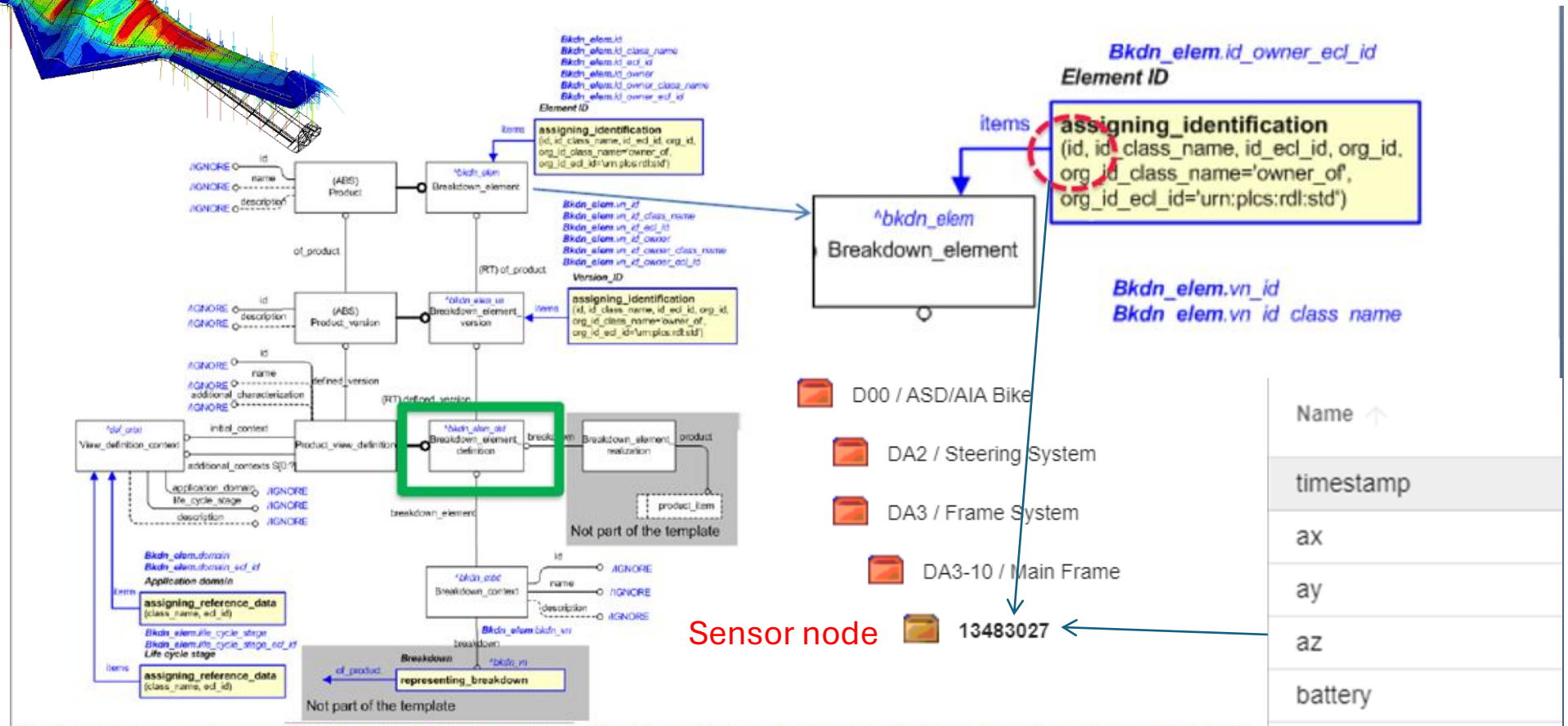






PROPERTIES IN ISO 10303 for Digital Twin



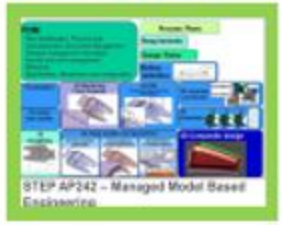


Jotne cooperation with PTC Windchill (PLM)

WINDCHILL STEP CONNECTORS

ptc

Detailed Design/BoM



windchill 11.0 STEP connector - AP242

Smart Connected PLM™

WNA-2488-F

Detailed Design/BoM

windchill 11.0 STEP connector - AP214

Smart Connected PLM™

WNA-2480-F

Operational Support

Reference data

PTC Windchill 11.0 STEP Connector - PLCS

Smart Connected PLM™

WNA-2481-F

S3000L

DEX1A&D
Product Breakdown for Support

DEX3A&D
Task Specification

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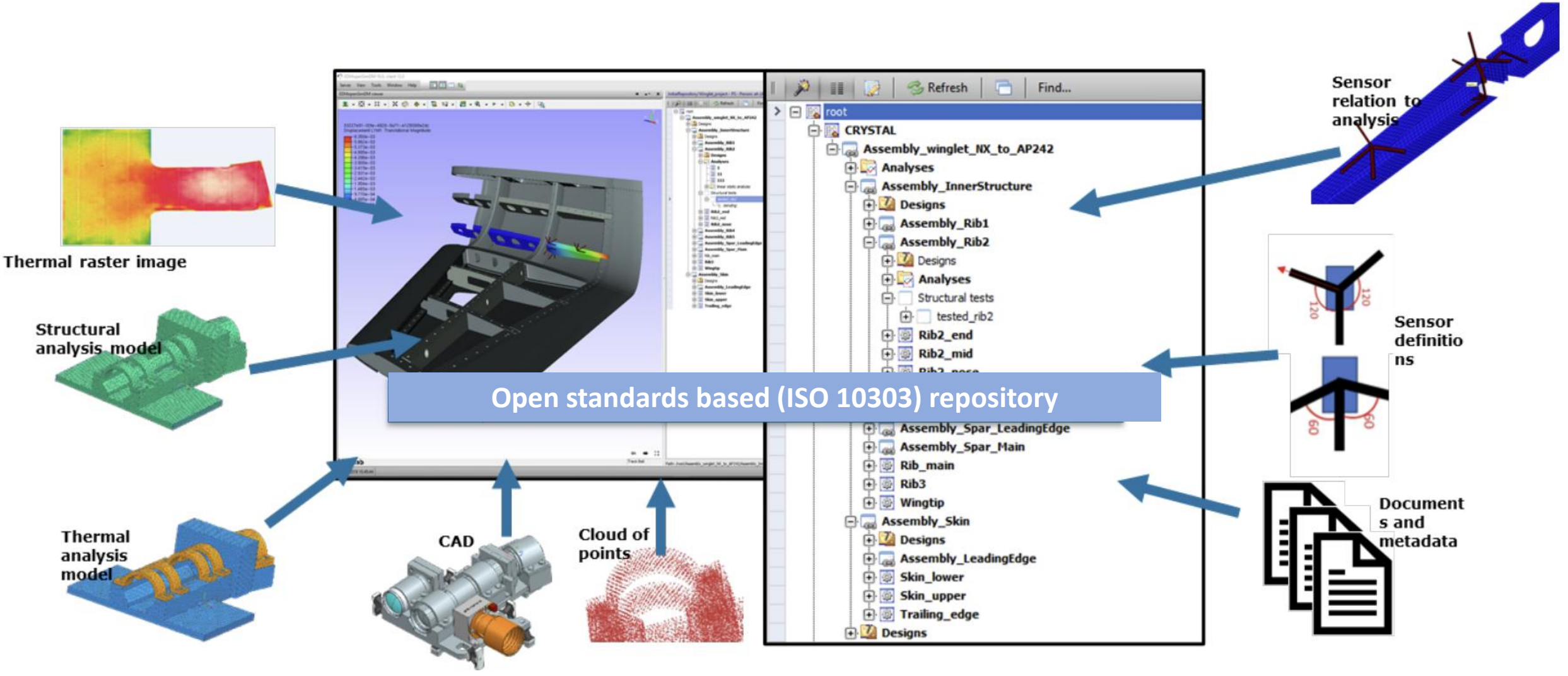
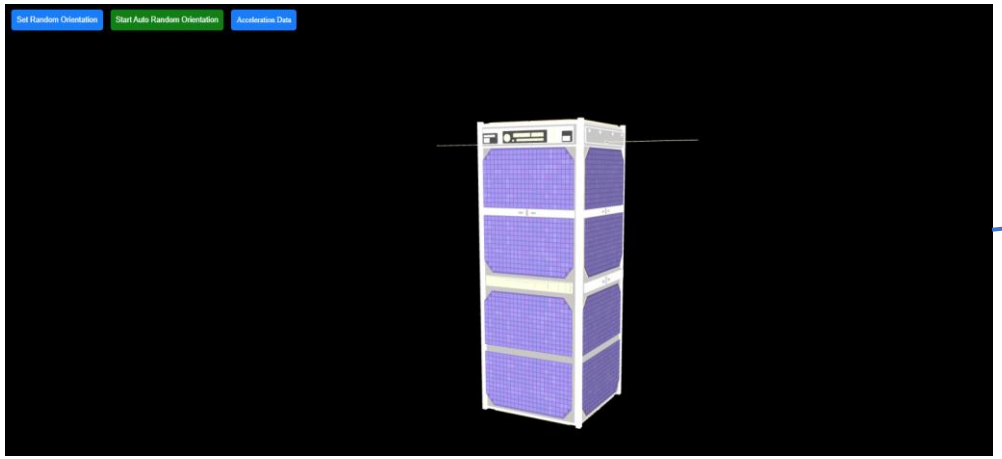
Validation and verifications
Digital Thread and Documentation



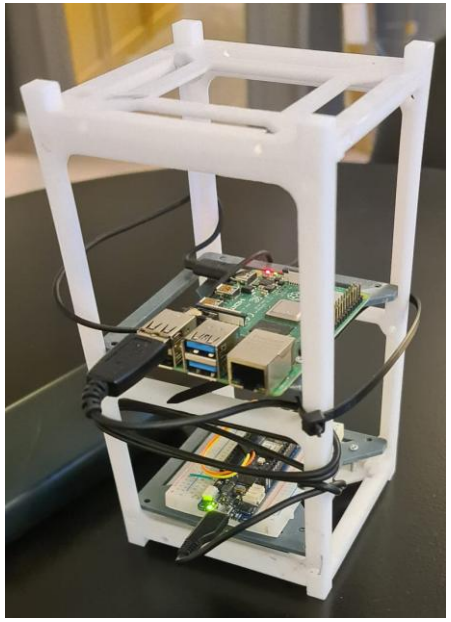
Digtial Twin of Cubesat

jotne connect

CubeSat 3D model



2RU Generic CubeSat 3D model : https://nasa3d.arc.nasa.gov/detail/cubesat-2RU



Breakdown properties | Document properties | Product properties

Num	Name	Value
1	Name	SENSORS
2	Type	BNO
3	Description	test
4	Created by	jotne_rc
5	Created date	10/9/2024, 1:43:23 PM
6	Last modified by	jotne_rc
7	Last modified date	10/9/2024, 1:43:23 PM

User defined

Num	Name	Value
1	sensor_readings	2625 items

EDMtruePLM representation of Aggregated sensor Data

from mm/dd/yyyy --:-- -- to mm/dd/yyyy --:-- -- APPLY DOWNLOAD

Table | Graph

Columns

Use reverse order | Show average values

Timestamp	Y (m/s^2)	X (m/s^2)	Z (m/s^2)	Heading (degree)	Pitch (degree)	Roll (degree)
5/31/2024, 12:58:55.170 PM	0.00	0.00	-0.17	321.12	1.56	-0.25
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5/31/2024, 12:58:58.167 PM	-0.02	0.01	-0.19	321.12	1.56	-0.25
5/31/2024, 12:58:59.169 PM	-0.02	0.01	-0.18	321.12	1.56	-0.25
5/31/2024, 12:59:00.167 PM	-0.02	0.00	-0.16	321.12	1.56	-0.25
5/31/2024, 12:59:01.166 PM	0.00	0.01	-0.19	321.12	1.56	-0.25
5/31/2024, 12:59:02.167 PM	-0.01	0.03	-0.19	321.12	1.56	-0.25
5/31/2024, 12:59:03.164 PM	-0.01	0.01	-0.18	321.12	1.56	-0.25
5/31/2024, 12:59:04.165 PM	-0.05	0.00	-0.17	321.12	1.56	-0.25

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CENSSAT-1 How it would look like in the ISO 10303 (STEP) PLM repository

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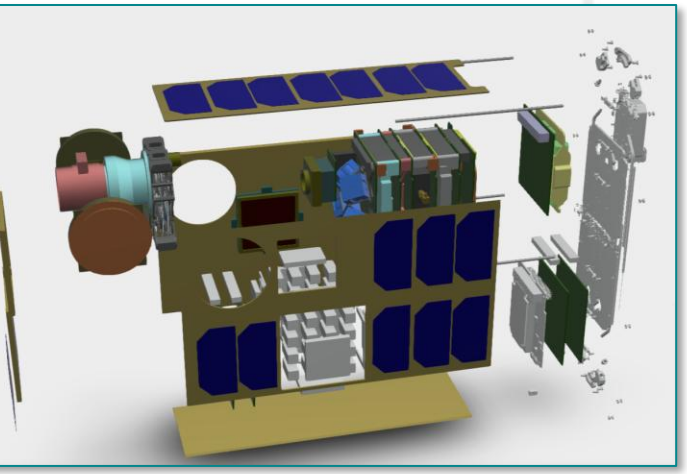
Mission-I > Mission-I (ver.39) >

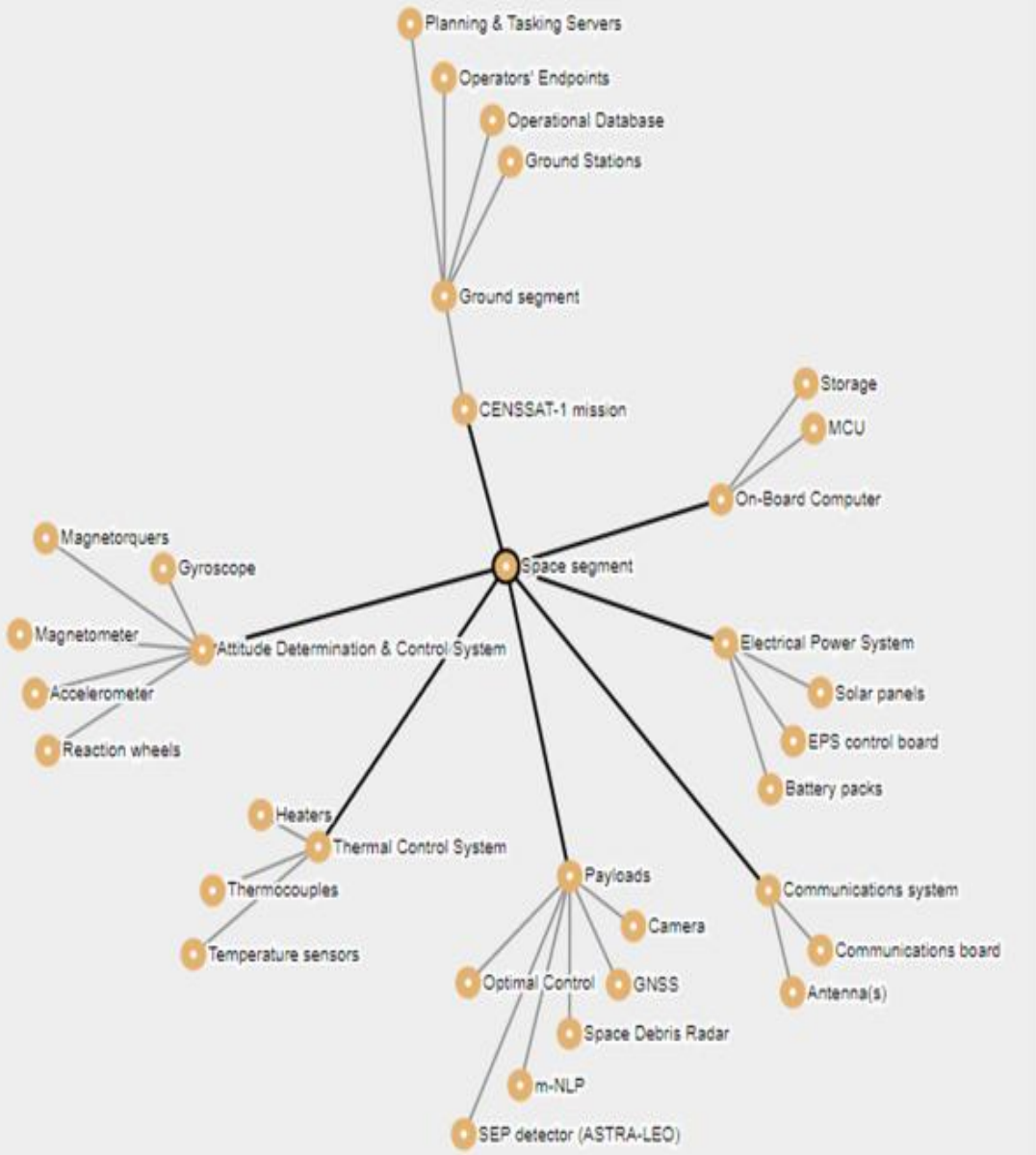
MISSION-I (VER.39)

CENSSAT-1 mission V:2 2/0

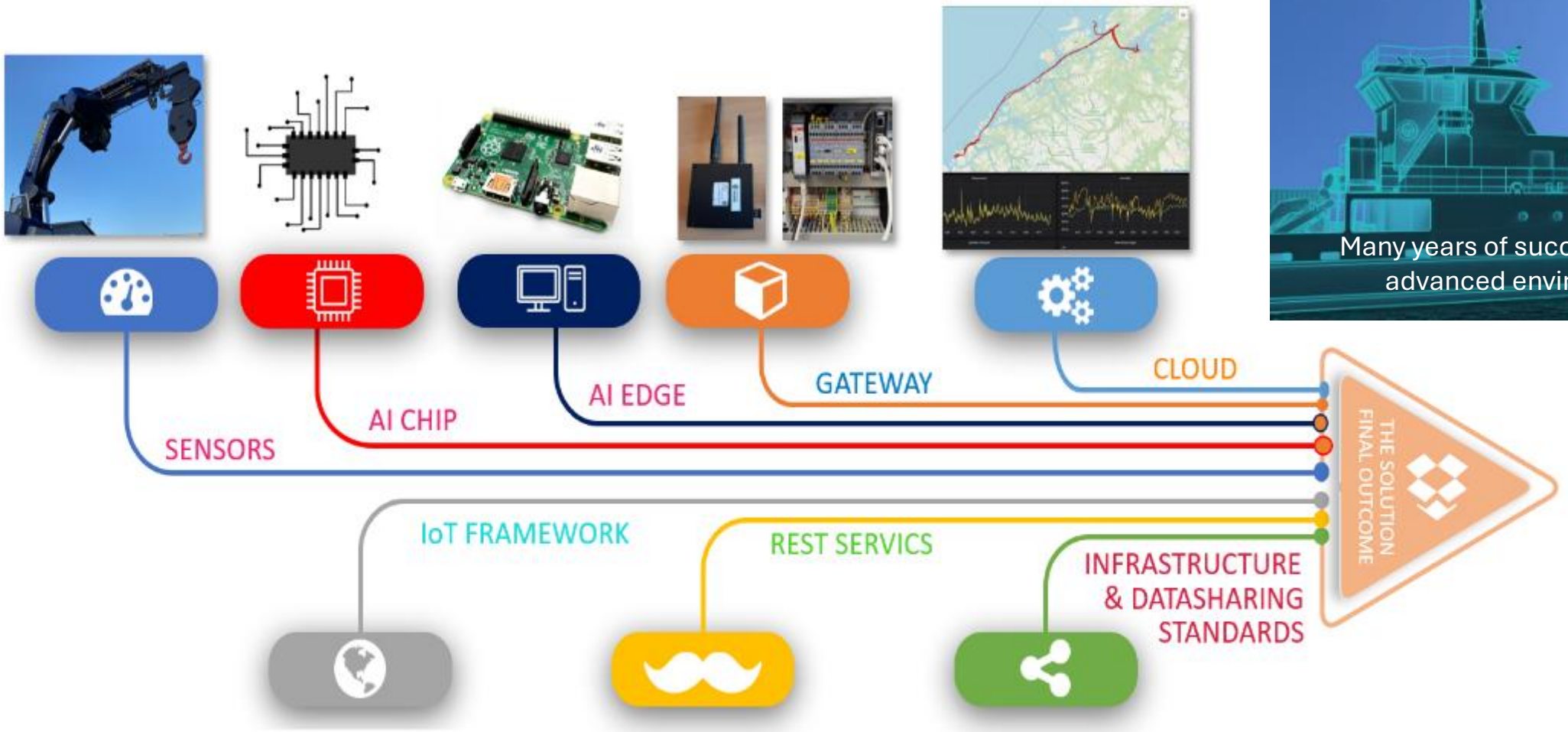
BREAKDOWN PROPERTIES | STRUCTURE TREE

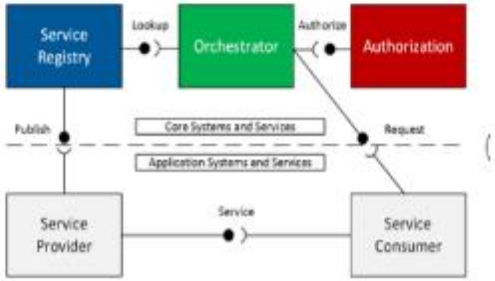
- Mission-I
  - CENSSAT-1 mission
    - Ground segment
      - Ground Stations
      - Operational Database
      - Operators' Endpoints
      - Planning & Tasking Servers
    - Space segment
      - Attitude Determination & Control System
      - Communications system
      - Electrical Power System
      - On-Board Computer
      - Payloads
      - Thermal Control System
        - Heaters
        - Temperature sensors
        - Thermocouples





Data analytics (AI+LLM)



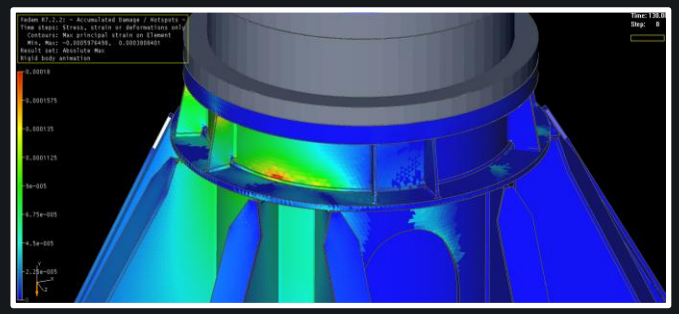


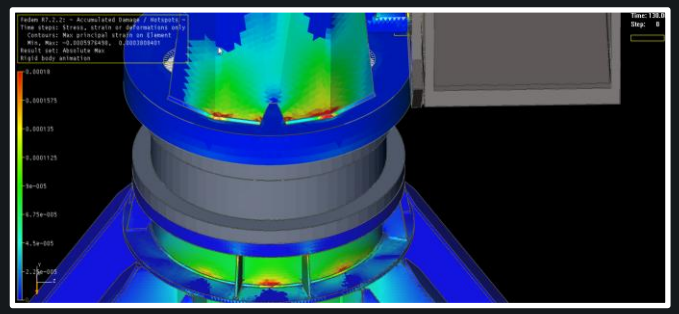
Crane Digital Twin Validation

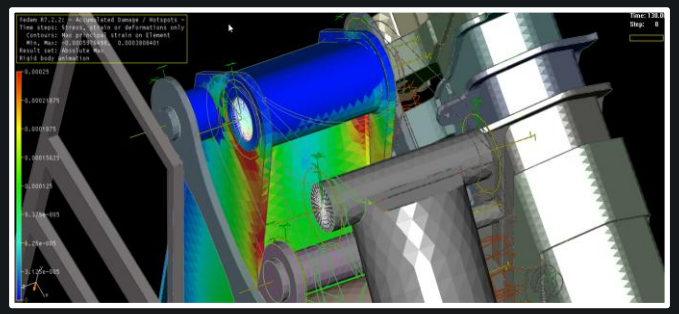
ARROWHEAD TOOLS

Crane deployment takes 130 seconds:

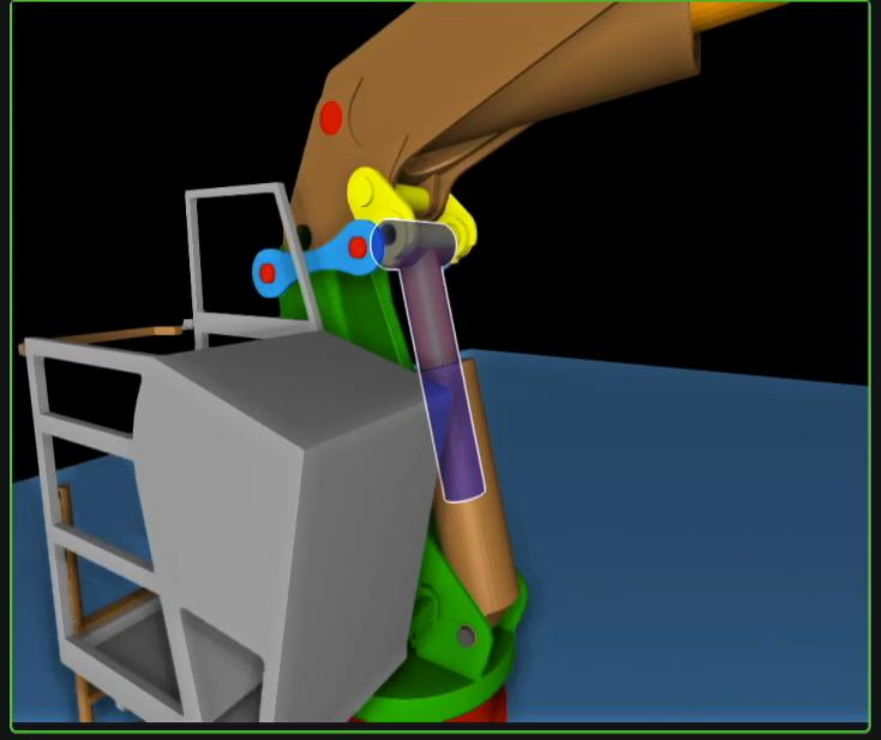
Simulation takes 75 seconds:

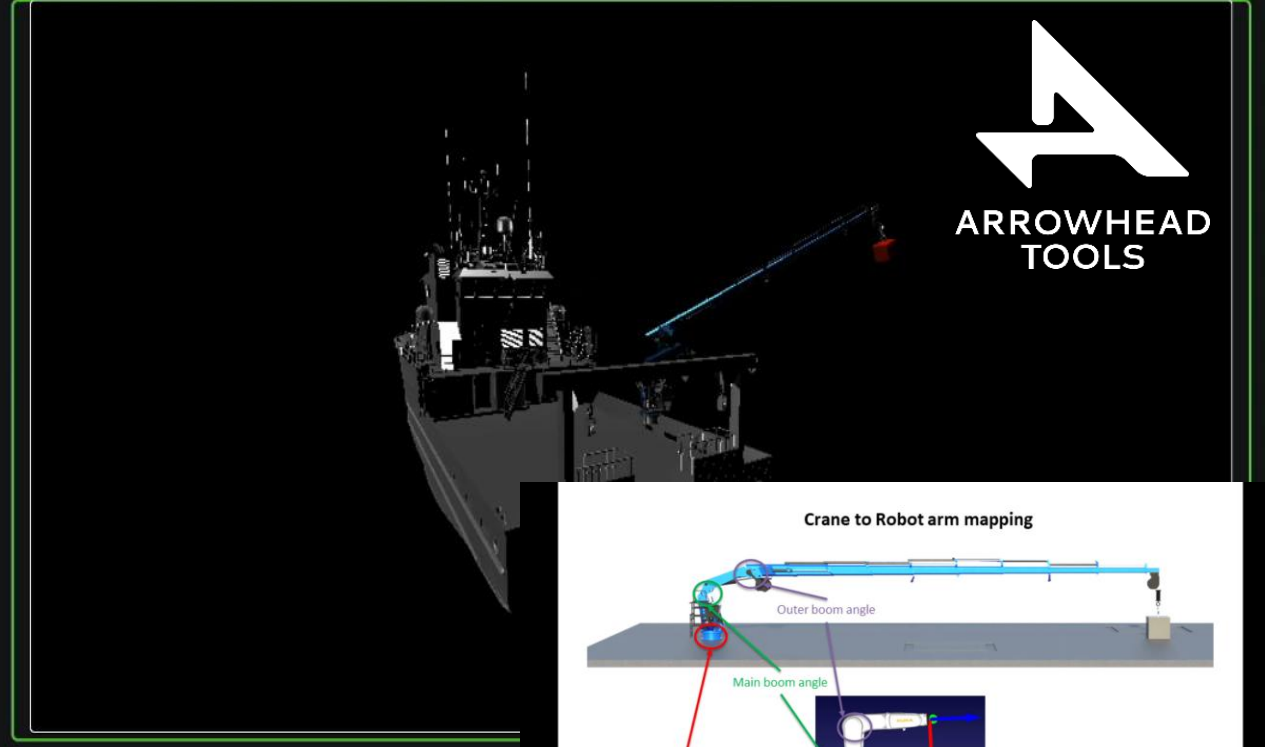


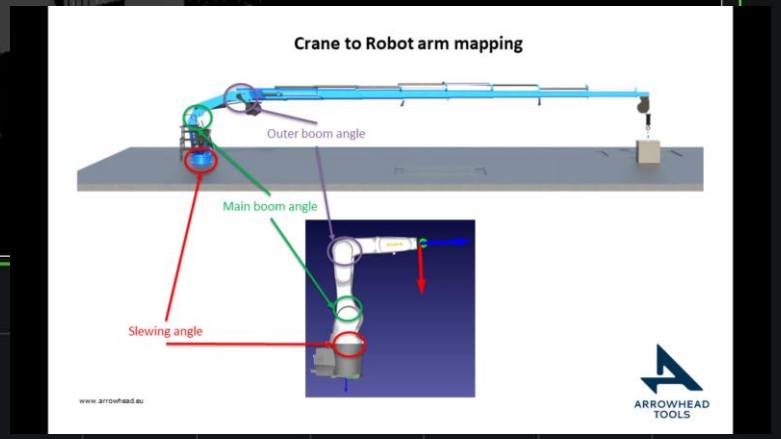




© Video from NTNU

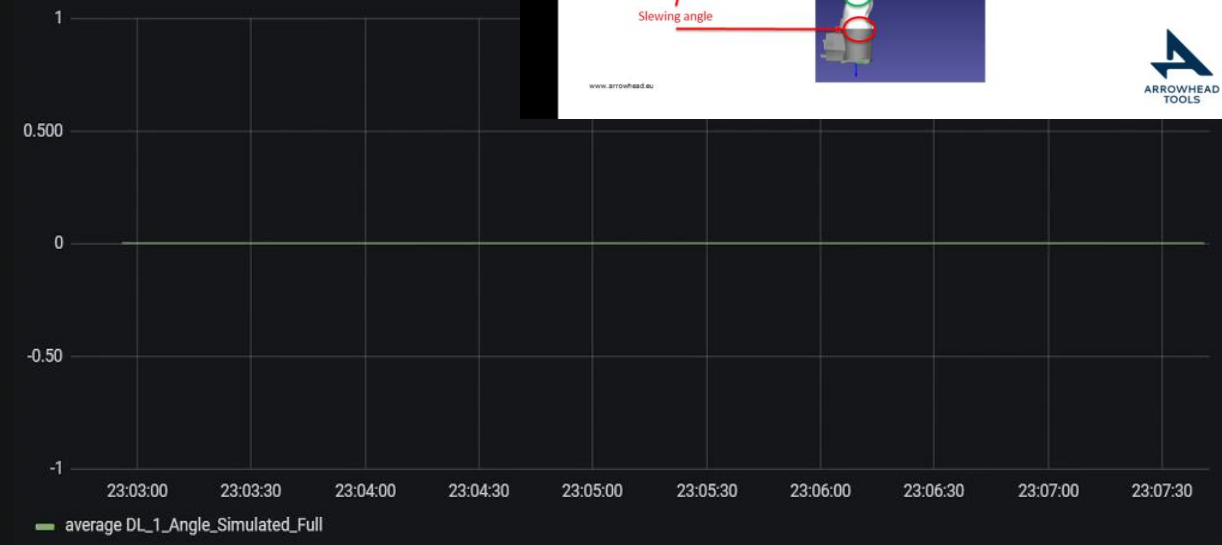






Main Cylinder Angle

- Main Cylinder Angle
- Second Cylinder Angle
- Outer Link Angle
- Outer Link Extension Length
- Slewing Angle



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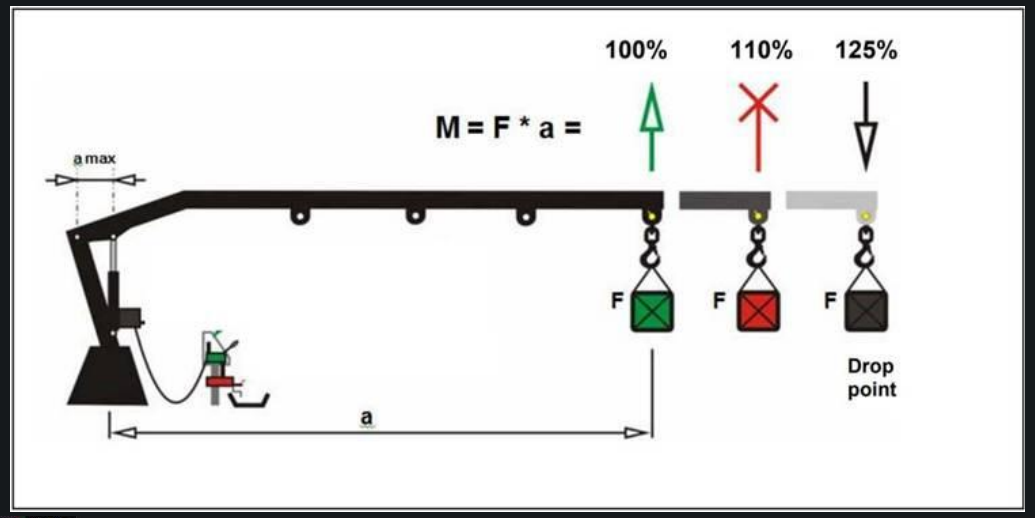
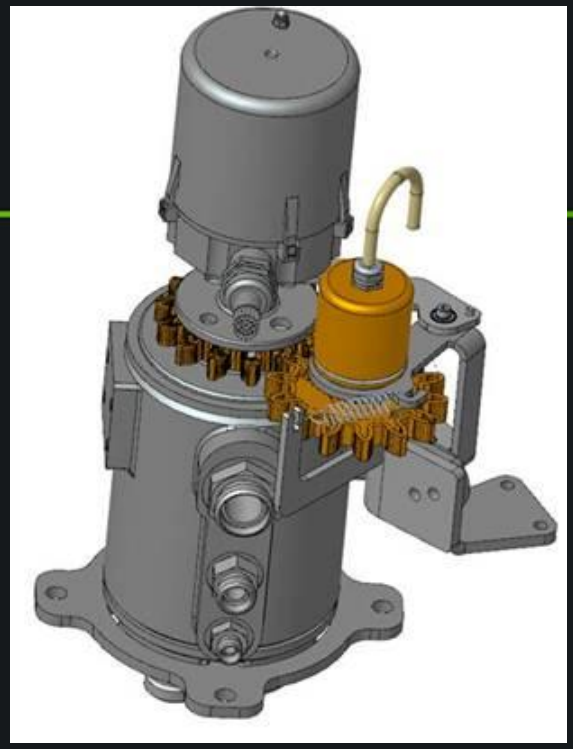
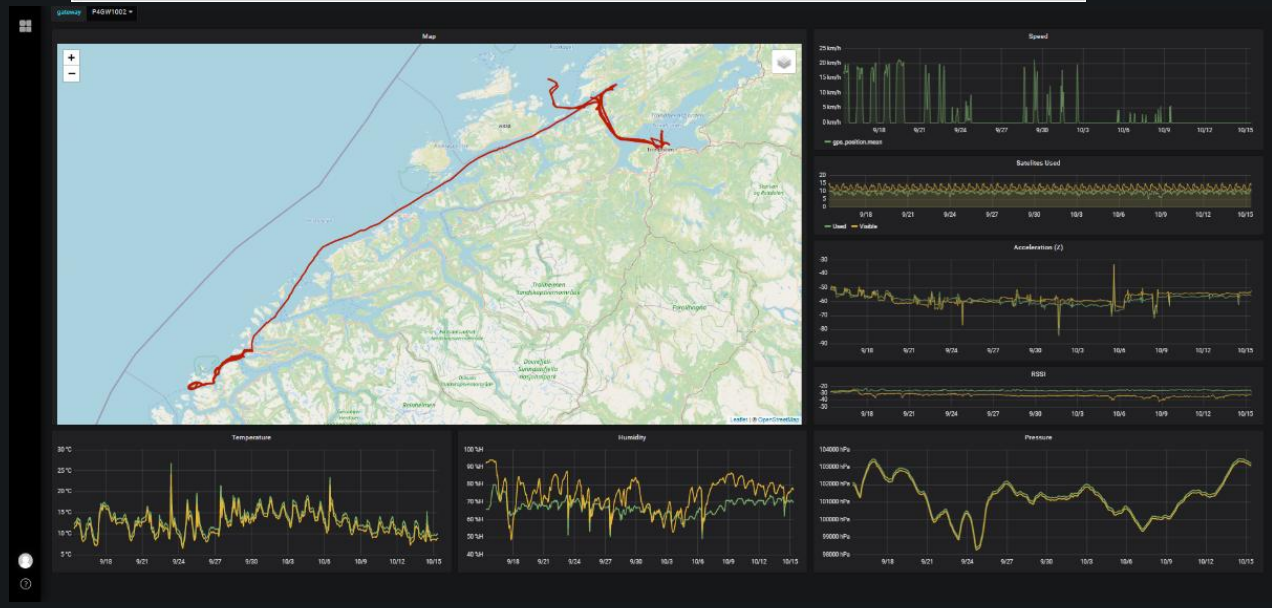
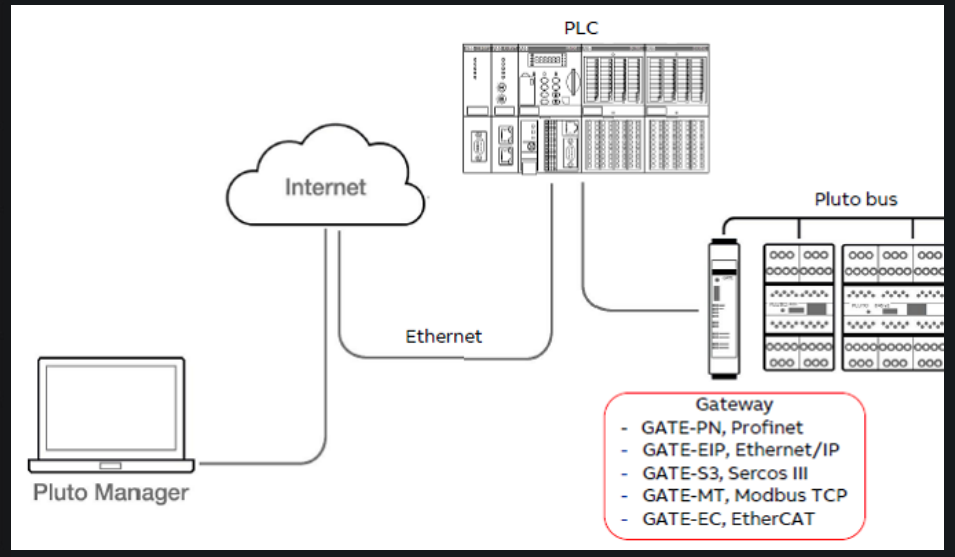
Sensors installed









References

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- The ISO video on Industrial Data.
- Jotne background on standards.
- Jotne presentation at the Boeing GPDIS event. (The ESA METRIC project)
- Simulation and Testing of Space components using STEP (The ESA DEFINE project)
- The Lockheed Martin and the MBE Playbook (based on ISO 10303-AP 242 and Jotne largest customer)
- PhD paper on STEP for Simulation
- Jotne R&D.

- Jotne and Lockheed Martin Expand Partnership to Drive Digital Engineering Transformation
- Home - Jotne Connect
- Visualizing the Digital Thread and Digital Twins | Lockheed Martin
- Digital Twin: Definition & Value – An AIAA and AIA Position Paper - Aerospace Industries Association
- dTHOR – Digital Ship Structural Health Monitoring
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