DATAWEEK

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From “Big” to “Extreme”, or how to increase the value from data analytics session

VesselAI Project

EUHUBS4DATA

BDV BIG DATA VALUE ASSOCIATION

Hello! My name is Spiros Mouzakitis

My professional work is focused on Intelligent Decision making, AI and software development

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VesselAI Vision

Develop, validate and demonstrate a novel holistic framework based on a combination of the state-of-the-art **HPC**, **Big Data** and **AI technologies**,

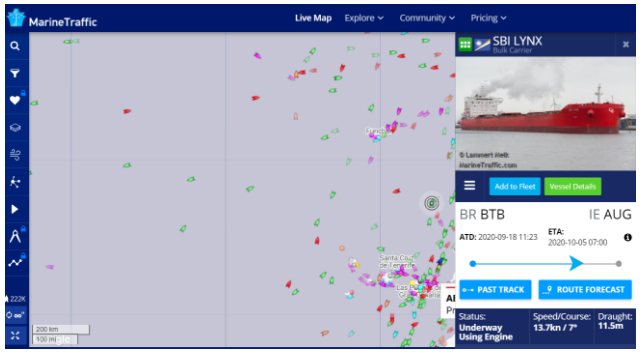
capable of **performing extreme-scale and distributed analytics** for **fueling the next-generation digital twins** and maritime applications, including:

- vessel motion and behavior modelling analysis and prediction,
- ship energy system design and optimisation
- unmanned vessels
- route optimisation
- fleet intelligence

Technical Challenges

- Efficient ingestion, cleansing, and enrichment of extreme-scale data sets from different sources is a complex and resource-intensive process
- Manage the end-to-end lifecycle of AI models in terms of training, validating, improving and serving.
- Build, trigger, orchestrate and serve applications based on the outcome of AI models.
- Utilize HPC architectures and AI-accelerators to enhance the execution of analytical pipelines.
- Integrate the technical outcome with existing maritime systems and applications.

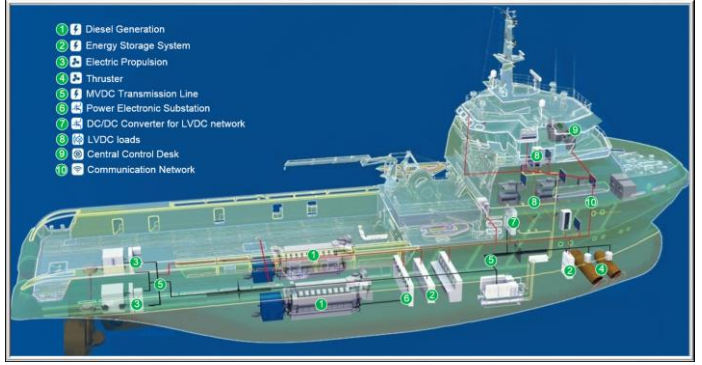
VesselAI
Pilot cases



1

Ship Modelling for global vessel traffic monitoring and

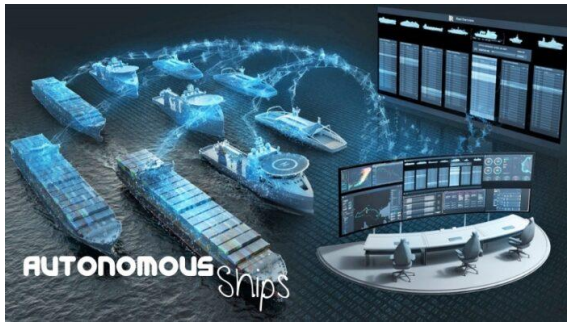
MarineTraffic



2

Globally Optimal Design of Ship Energy Systems

VTT



3

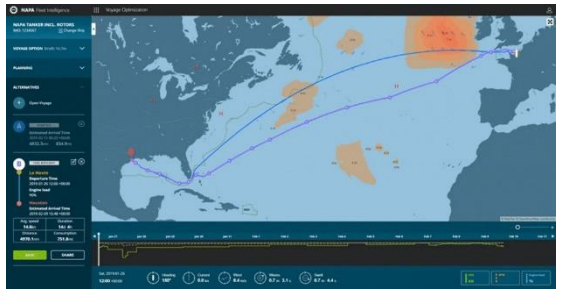
Autonomous ships in short sea transport

SINTEF DIGITAL

SINTEF OCEAN

KONGSBERG

massterly
a Kongsberg Wilhelmsen Joint Venture



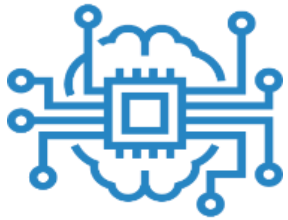
4

Weather Routing and Fleet Intelligence Service in Shipping

NAPA

DW

AI models of VesselAI



Vessel Route/Traffic Forecasting

- Long route (MT)
- **EnvCLUS, EnvCLUS*** — *clustering and graph theory*
- Short route (UPRC)
- **VRF** — *ANN*

Vessel Traffic

- Traffic Flow (UPRC)
  - **VTFF** — VRF & ANN
  - *MaSEC*
- Vessel Traffic Density (UNINOVA)

Shore Control Decision Support in Oslo Fjord

- Route prediction (SINOCE, SINTEF, KNC)
- **Route clustering** - *DBSCAN*
- **Route forecasting** - *Autoregressive RNN*
- *Anomaly Detection (SINTEF, SINOCE, KNC)*
- Collision Risk Assessment (UPRC)
- **VCRA** - *ANN*

Ship Design Optimization

- Ship energy system performance (VTT)
- **Surrogate models to provide an estimate of objective value** - *Gaussian process regression models (full/sparse variational, variational nearest neighbour)*
- Ship Engine information (VTT)
- **Information extraction from PDF** - *keyword matching, clustering & NN*

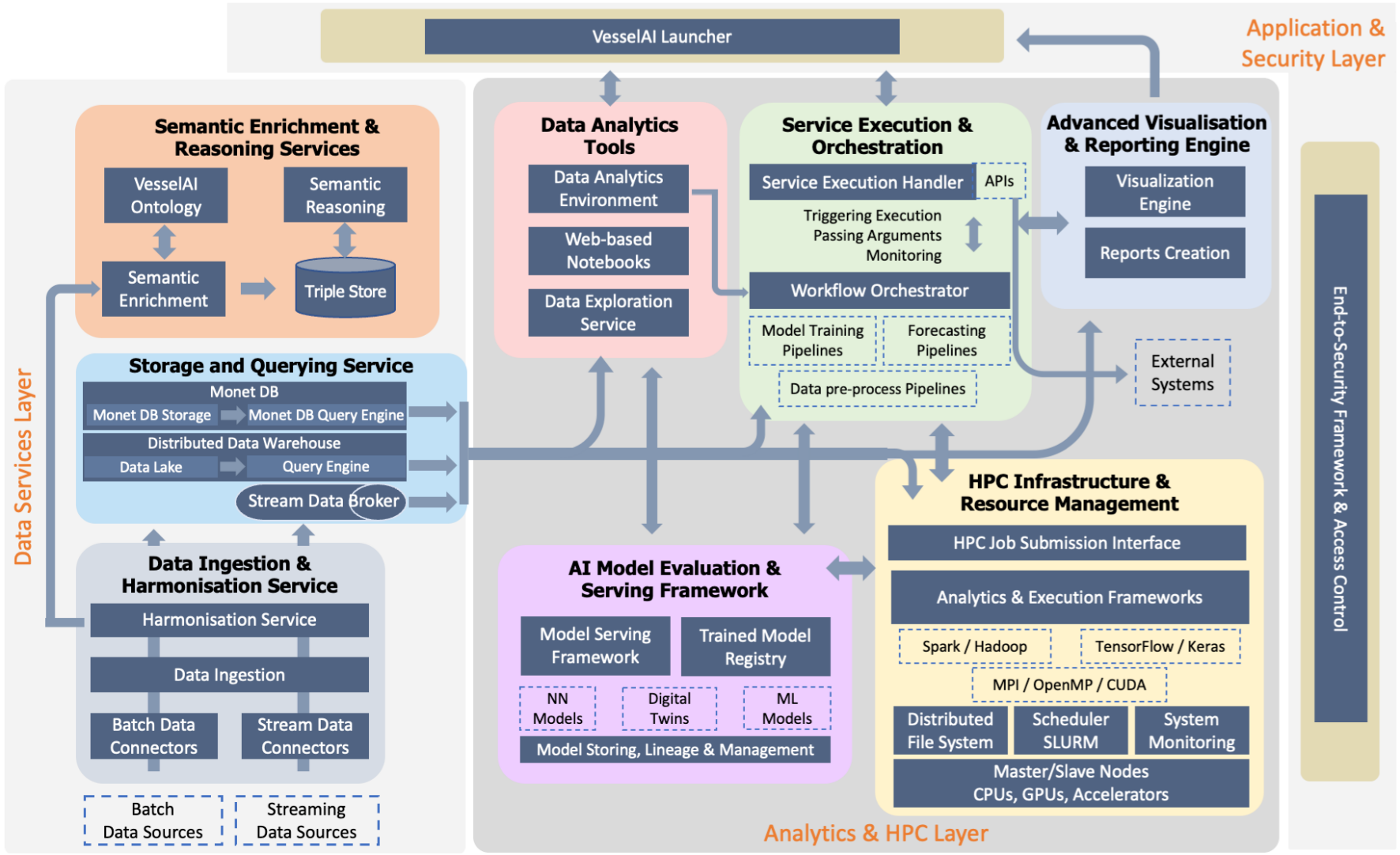
Route planning

- Port Infrastructure (UH)
- **Port mooring, anchorage identification** - *DBSCAN and genetic algorithm*
- Weather routing (UH)
- **Time dependant path finding** - *Dijkstra algorithm*
- **Point-based fuel flow prediction with real-time weather forecast** - *ANN*
- **Rerouting decision model** - *ANN*

CO_2 Emission, Fuel consumption

- **CO_2 Emission (NTUA)** - *linear/Ridge/Lasso/SGD regression, random forest, SVM*
- **Fuel Consumption (NTUA)** - *Regression and timeseries forecasting*

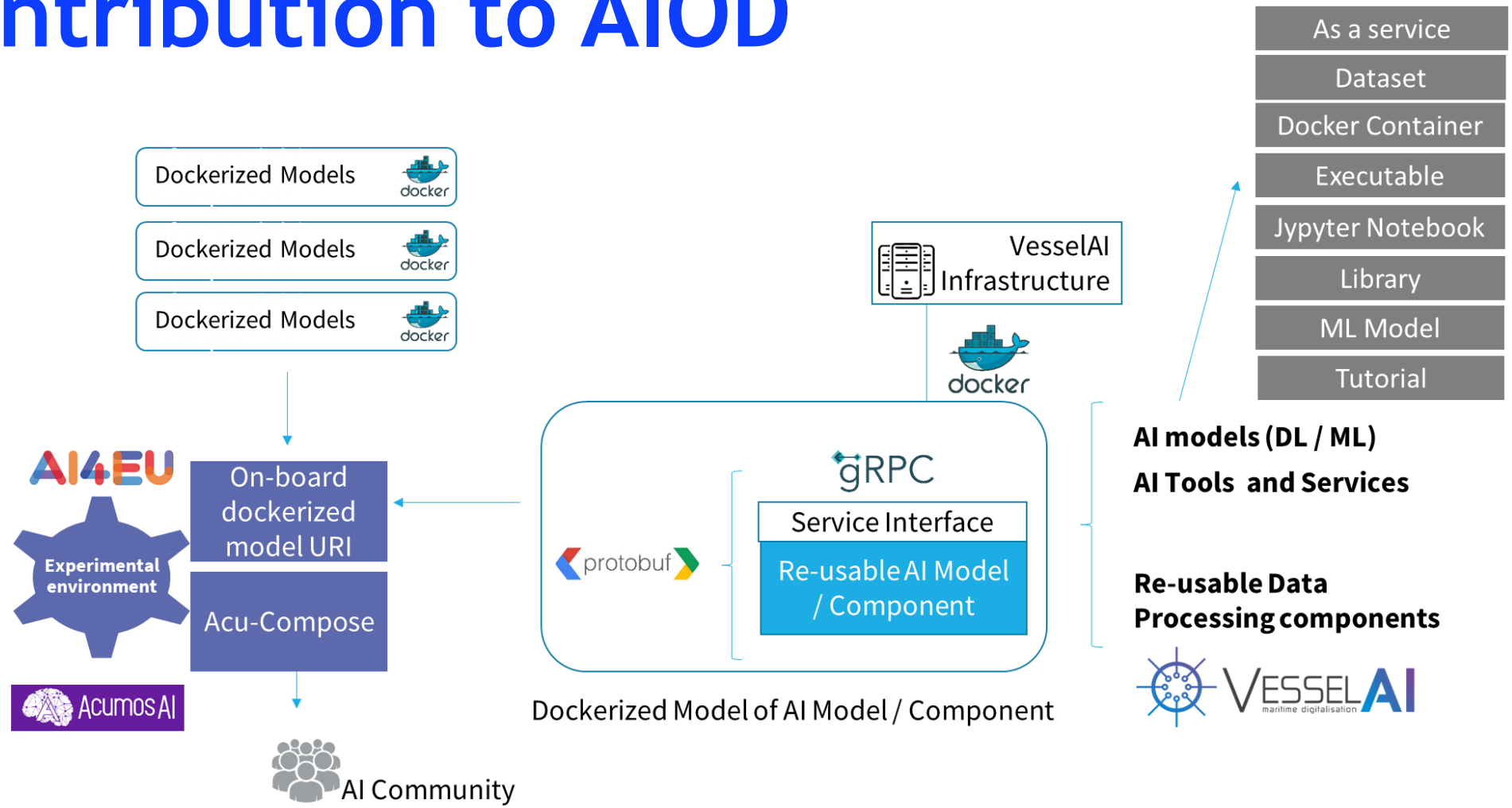
Architecture



VesselAI Tools / Assets

- VesselAI Launcher
- AI Model Evaluation & Serving Framework (MLflow – Minio)
- Advanced Visualisation & Reporting Engine (Superset, NTUA's Visualiser)
- Service Execution & Orchestration (Airflow, Service Execution Handler)
- Big Data Warehouse (Minio, Hive, Trino)
- Data Analytics Environment
- Security Framework (Keycloak, Security Enabler)
- Data Ingestion and Harmonisation Service
- Stream Broker (Kafka, KafkaDrop)
- Monet DB
- Semantic Enrichment Service (RDFgen)
- Triplestore
- Reasoning Engine (stLD, CEP)
- Data Exploration Service
- Jupyter Notebook

Contribution to AIOD



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Thank you!

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