ODYS COMPANY PROFILE

Web: www.odys.it

Contact: info@odys.it

ODYS
Advanced Controls & Optimization

ABOUT ODYS

- **ODYS S.r.l.** is a private SME founded in 2011, originally as a university spin-off
- **Mission:** Bring state-of-the-art academic research in **advanced controls and embedded optimization to production**
- **Primary expertise:** multivariable controls, real-time optimization, embedded numerical algorithms, machine learning for system modeling, diagnostics, fault detection, and self-calibration
- **Products and Services:**
  - **Consultancy** on control systems design and embedded optimization
  - **Software** for model predictive control (MPC) and real-time optimization: design, prototyping, and production deployment (C, MATLAB, Python)

IAS ACCREDITED Management Systems Certification Body MSCB-113

G-CERT SYSTEM SERVICE GKIT-0168-QC ISO 9001:2015

- **Experience with application domains:**

automotive

robotics

aerospace

energy

quant finance

SOME OF OUR CLIENTS AND PARTNERS

- Supplier of several **OEMs** and **Tier-1 suppliers** in automotive, robotics, aerospace, finance worldwide

… and others under NDA's

- Active in **EU** and **European Space Agency** projects

Read more: https://www.odys.it/projects/

ODYS EXPERIENCE IN AUTOMOTIVE

First known applications of real-time MPC in automotive mass production!

and more are underway…

SAE INTERNATIONAL
WCX 2018

Model Predictive Control of Turbocharged Gasoline Engines for Mass Production

Alberto Bemporad and Daniele Bernardini ODYS SRL

Ruixing Long and Julian Verdejo General Motors LLC

SAE INTERNATIONAL
WCX 2018

Supervisory Model Predictive Control of a Powertrain with a Continuously Variable Transmission

Alberto Bemporad and Daniele Bernardini ODYS Srl

Michael Livshiz and Bharath Pattipati General Motors LLC

Controls solved in **real-time** on ECU

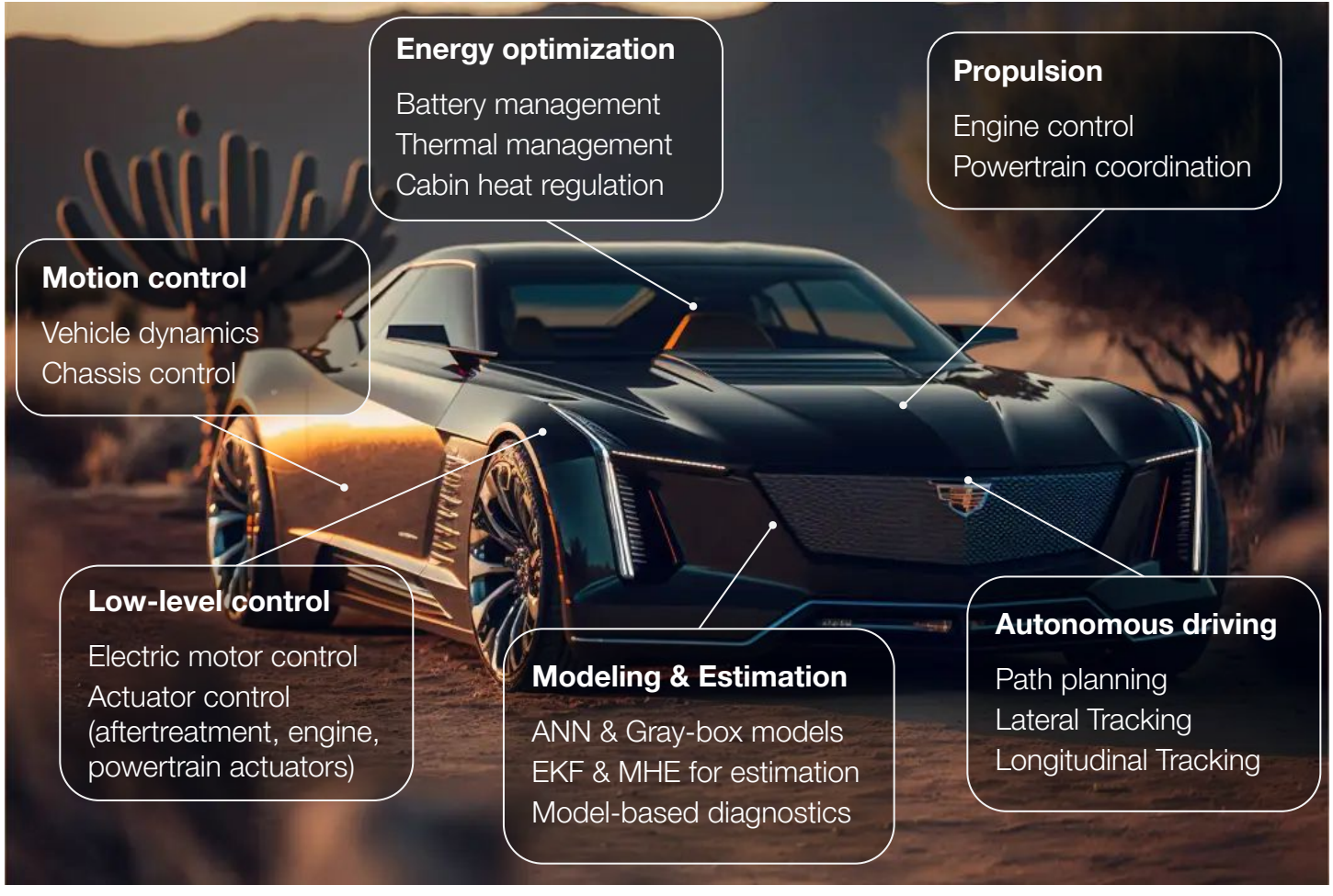
Zero solver failures

SAE Environmental Excellence in Transportation (E2T) Award 2021

"LPV-MPC of Two-CAN SCR Catalysts"

ODYS real-time embedded optimization and MPC software is currently running on more than 3 million vehicles worldwide

ODYS EXPERIENCE IN AUTOMOTIVE



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ODYS IN THE AEROSPACE INDUSTRY

MELiSSA
MICRO-ECOLOGICAL LIFE SUPPORT SYSTEM ALTERNATIVE

ODYS serves as the **control systems expert** for several Life Support Systems projects within the **ESA** MELiSSA framework

- Design and coordination of more than 15 control loops in a **Plant Characterization Unit**, with ~120 measures and ~80 actuators

  [1] A Plant Characterization Unit for Closed Life Support: Hardware and Control Design for Atmospheric Systems, A. Pannico et al., Frontiers in Astronomy and Space Sciences, 2022

- Advanced algorithms for **biological signatures** estimation, **hydroponic** and **atmospheric** control

  [2] Hybrid Model Predictive Control for the regulation of carbon dioxide in plant growth chambers, G. Cimini et al., Computers and Electronics in Agriculture, 2026

- Modeling and **supervisory control of circular and bio-regenerative networks** in solid, liquid and gas phases

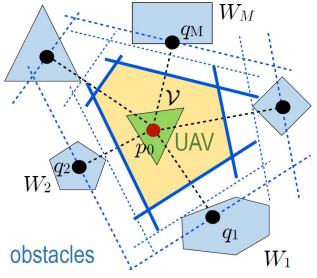
  [3] Towards supervisory Model Predictive Control for circular life support systems in long-term space missions, G. Cimini et al., Life Sciences in Space Research, 2025

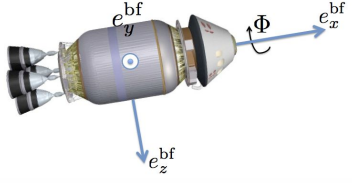
youtube.com/watch?v=XqjXBj_jljM

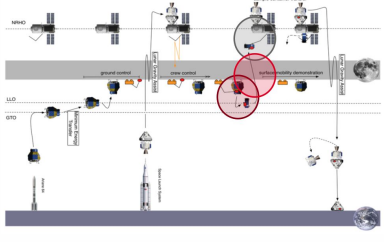
ODYS IN THE AEROSPACE INDUSTRY

ODYS team has experience in multiple **ESA-funded projects** where **MPC** is the core enabling technology:

- ORCSAT: **On-line reconfiguration** control system and avionics technologies
- ROBMPC: Robust MPC for space constrained systems
  - unmanned **UAV navigation** in nonconvex space
  - decentralized MPC for **formation flying** of quadcopters
- GUIBEAR: MPC for **rendezvous** under observability constraints
- MPC for Adaptable Space Applications (ESTEC NPI)
- MPC for **attitude control** of launcher upper stage under sloshing
- VARSITY: MPC for the coordination of **life support systems** compartments



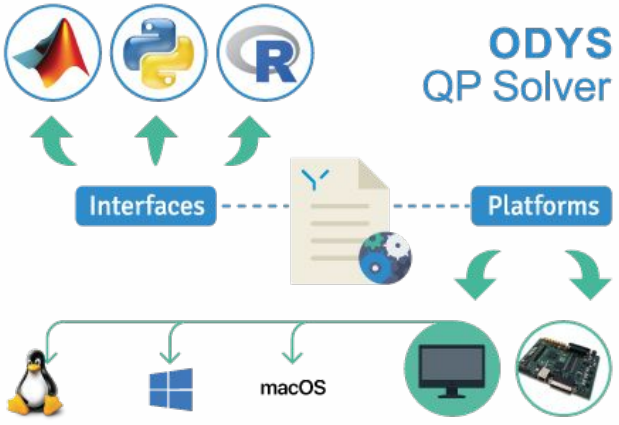




ODYS QP SOLVER

- **ODYS QP Solver** minimizes convex Quadratic Programming (QP) problems in the form:

$$\begin{aligned} \min_{z} \quad & \frac{1}{2} z^\intercal H z + h^\intercal z \\ \text{s.t.} \quad & Ez = e \\ & b_l \leq Gz \leq b_u \\ & z_l \leq z \leq z_u \end{aligned}$$



- Emphasis on **execution speed** (both in average & worst-case), **low memory footprint**, and **robustness** (also in single precision)
- Execution is **fast** on average and **predictable** in the worst-case
- **MISRA-C** compliant, library-free C code
- **Certifiable execution time**
- **ISO 26262 ASIL B** certification in progress
- Version **optimized for MPC** integrated in **ODYS Embedded MPC**
- Detailed **benchmark**: slides and video

Faster, more reliable and **memory efficient** than all tested competitors

odys.it/qp

ODYS EMBEDDED MPC

- **ODYS Embedded MPC** is a software library for implementing MPC in **real-time applications**

Main Functionalities

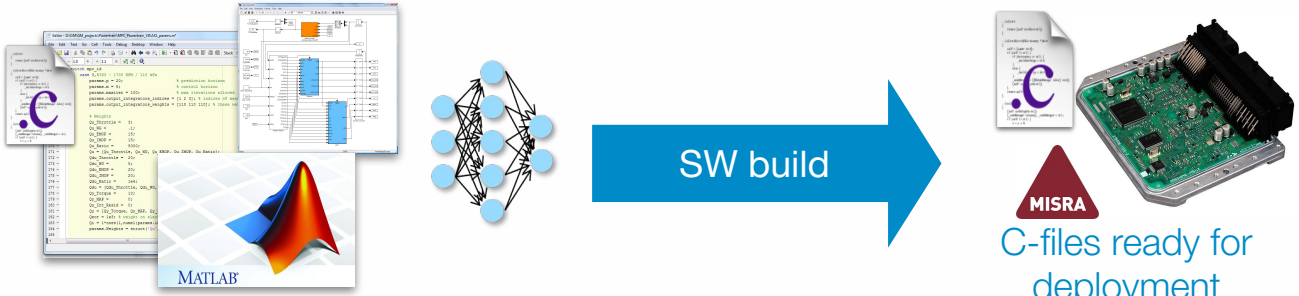
LTV and Nonlinear MPC implementation

Extended Kalman Filter and Moving Horizon Estimator

Automatic integration, discretization, and differentiation

User-friendly MPC advisor tool

- Emphasis on execution speed, numerical robustness, limited memory footprint
- Support for advanced control design functionalities
- **MISRA-C compliant, library-free C-code,** no dynamic memory, single & double precision



Control design, calibration and testing in simulation

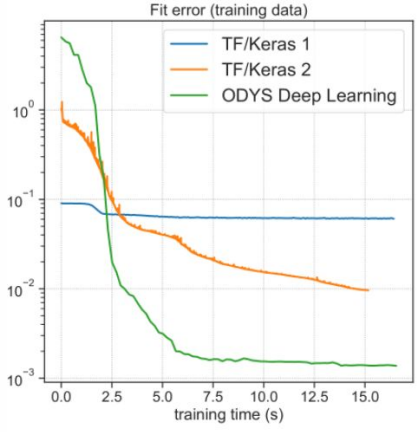
C-files ready for deployment

odys.it/embedded-mpc

ODYS LEARNING-BASED MPC

The **Deep Learning Toolset** is a plugin for ODYS Embedded MPC, available in MATLAB and Python for developing **prediction models based on neural networks**

- **Python interfaces** to most common machine learning libraries (TensorFlow/Keras, scikit-learn, PyTorch)
- **Very efficient proprietary algorithms** for training small-scale neural networks, typical in embedded MPC
- **Automatic generation of optimized C-code** of neural network models & Jacobians for MPC
- **Online learning and adaptation** also supported for adaptive MPC



Neural network training:
5 inputs, 3 outputs
3 hidden layers (10+10+10)
5,000 training samples

➢ *Ongoing developments under the **Eureka Eurostars** project "SLIMPEC"*

`odys.it/deep-learning`

www.odys.it