

**FORCES PRO – REAL TIME
DECISION MAKING SOFTWARE**

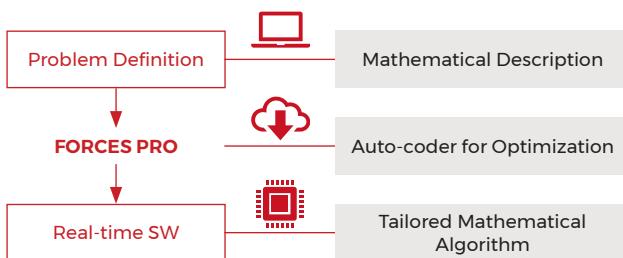
embotech*

FORCES PRO – Pioneering software for real time decision making

FORCES PRO software empowers autonomous systems to make decisions by solving complex optimization problems in milliseconds. The numerical software developed by Embotech enables model-based, real-time optimal control, Model predictive control (MPC) and decision-making solutions for fast systems. Based on auto-coding, it is designed to solve complex motion problems, provided a mathematical description by the user. FORCES PRO brings significant improvements in safety, productivity and energy efficiency. Current applications include automotive, aerospace and industrial solutions.

HOW IT WORKS

FORCES PRO promotes the use of physical models and uses a deterministic mathematical approach with numerical optimization to automatically generate an embeddable solver. The user defines the problem. The solver generates a tailored, embeddable mathematical algorithm.



ADVANTAGES

High performing: Most efficient commercial code for optimization on smart machines.

Embeddable everywhere: The only optimizer so small that it runs on any commercial platform.

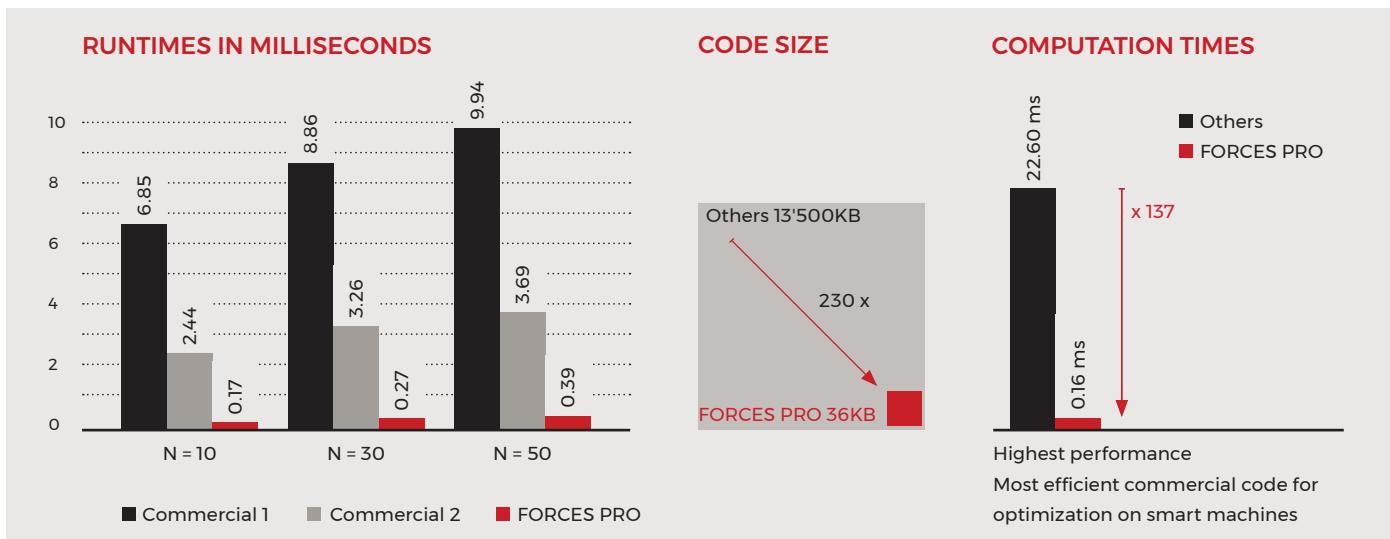
Easy-to-use interface: Matlab and Python interface.

OTHER SPECS

- C code tailored for deployment on embedded systems
- No dependency on external libraries
- Wide range of algorithmic options including SOCPs and NLPs
- Static memory allocation
- MISRA-C compliant
- Platform-specific optimizations
- Extremely optimized for memory and speed

PLATFORMS

- Windows/Linux/MacOS
- NVIDIA Drive PX2
- ARM Cortex A7, 8, 15, 53, 72 etc.
- NXP S32 (Blue Box)
- dSPACE MicroAutoBox II
- Speedgoat
- Greenhills Integrity
- Bachmann
- National Instruments cRIO
- Other platforms upon request



FORCES PRO – Applications

Applications of FORCES PRO include:

- Autonomous vehicle racing
- Emergency obstacle avoidance
- Energy management for hybrid trucks
- Wind Turbine pitch control
- Guidance/motion planning for spacecraft
- Sheet metal laser-cutting/bending optimization
- Robotic arm motion planning optimization
- Drones flight optimization for cinematography
- Combustion engine airpath and idle speed control
- Customised applications depending on interest

Selected cases:

1. ENERGY MANAGEMENT FOR HYBRID TRUCKS

Problem: Actively extend fuel efficiency and range of hybrid and fully electric vehicles given traffic and road profile information ahead

Solution: Powertrain optimization: real-time, long-horizon energy manager for hybrid and fully electric powertrains which respects passenger comfort requirements, optimizes fuel efficiency and range

Results: 7 % less fuel consumption and 20 % less electric load on a hybrid truck powertrain demonstrated

2. WIND TURBINE OPTIMIZATION

Problem: Wind gusts can lead to significant wind turbine tower vibration and generated power fluctuations

Solution: MPC and numerical optimization embedded in turbine software in order to maintain power whilst minimizing vibration

Results: Great performance measured on power production, operating flawlessly on turbines in the field +20'000 hrs of safe operation, both the maximum and average load on the tower are being reduced through a software update

3. SHEET METAL PROCESSING OPTIMIZATION

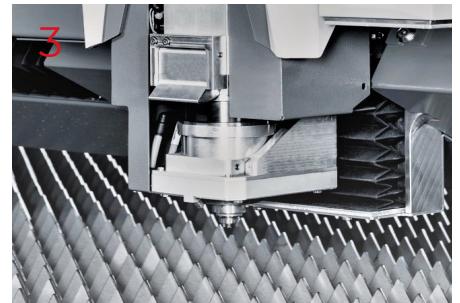
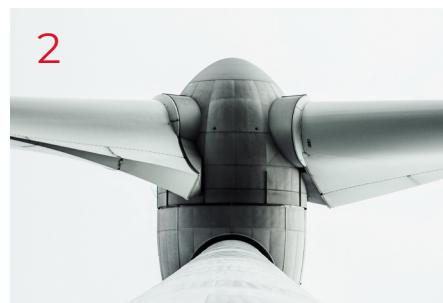
Problem: Maximize speed and efficiency of motion of laser cutters, bending machines, sorting machines and robotic arms

Solution: MPC and numerical optimization embedded in industrial machine in order to optimize the motion of robotic laser arm combining motion and process model to achieve optimal efficiency

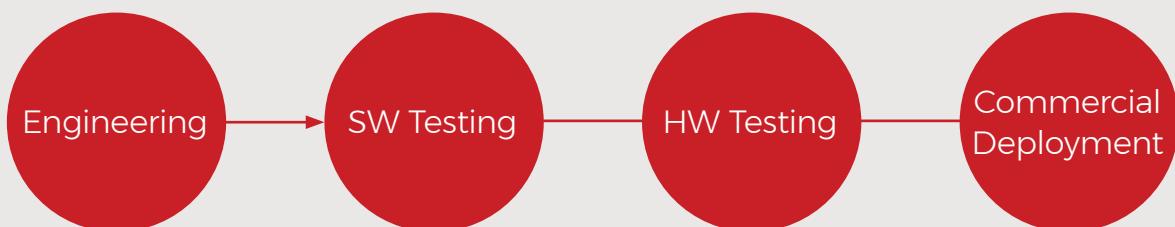
Results: 30 % faster cutting speeds for laser machines

ADDITIONAL FORCES PRO SERVICE PACKAGES

- Expert consulting for problem formulation
- Consulting & development for customized solutions
- Training



FORCES PRO LICENSING SCHEME



License per user
(up to 2 PCs)

License per node
Sil / CI

License per node
HiL/Field testing

License per node
Field deployment

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Embotech is a leading developer of cutting-edge decision-making software. Our embeddable software empowers autonomous systems to make decisions by solving complex optimization problems in milliseconds, bringing significant improvements in safety, productivity and energy efficiency. Current applications include automotive, industrial and aerospace solutions.