EICASLAB™ DEMO

The Professional Software Suite
for Automatic Control Design and Forecasting

Demo Presentation

EICAS Automazione S.p.A.
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What is EICASLAB DEMO?

EICASLAB DEMO shows you how EICASLAB Suite can help you in all phases of control design, by presenting a set of test cases (Demo projects) implementing the most common control algorithm techniques, applied to a “rotating table” single axis control application.

Control Structures

DEMO

Control Algorithms

- *PID*
- *Classical Model Based*
- *EICAS Model Based*
- *User*

Control Architectures

- Measure of the motor angular position;
- Measure of the rotating table angular position;
- Measures of both motor angular position and rotating table angular position (hierarchical control).

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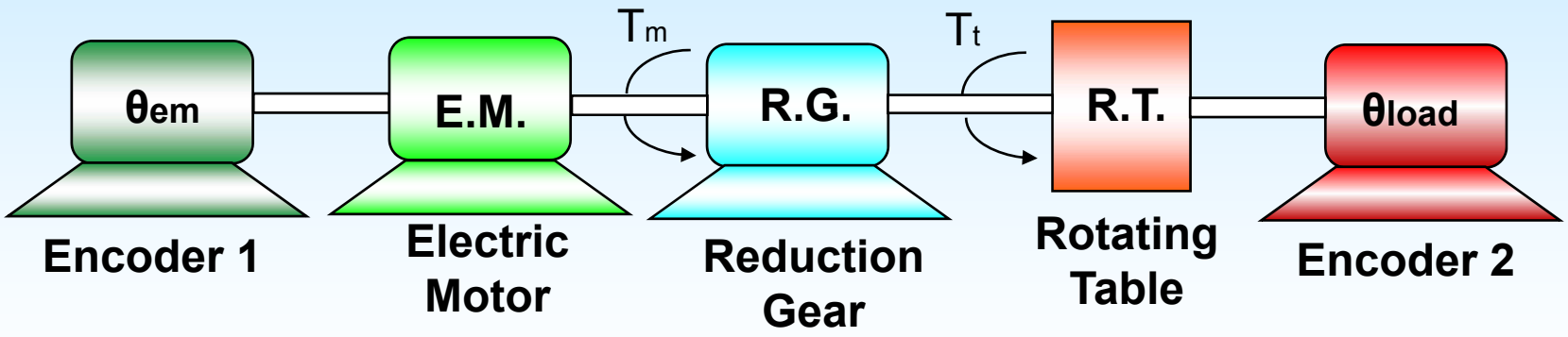
The Test Case: the rotating table control design

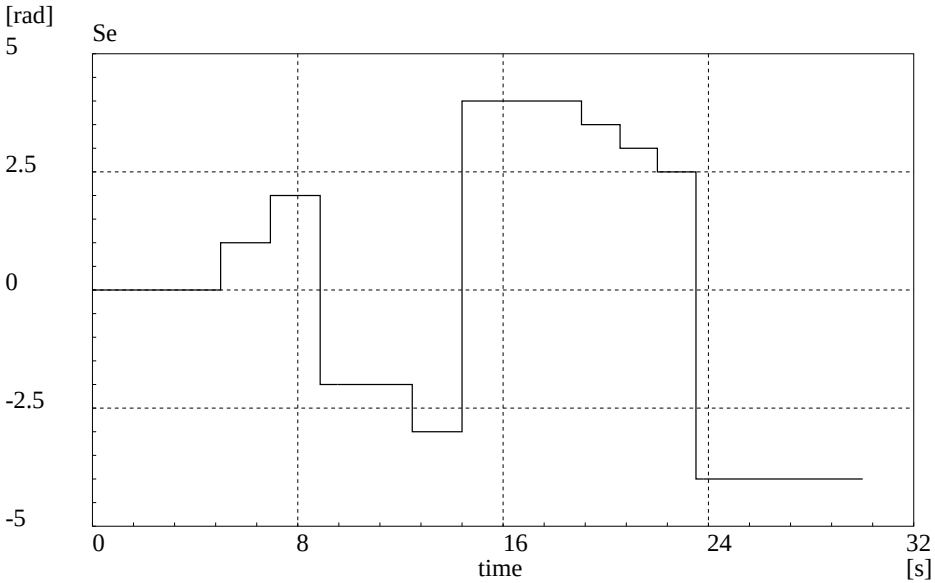


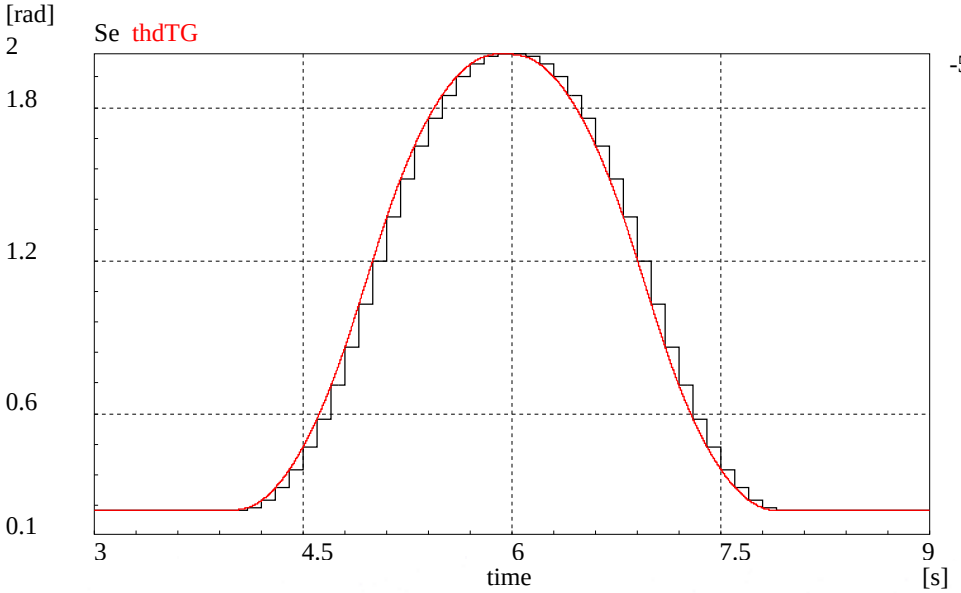
System Requirements

Motor electric current	12 A
Maximum motor electric current	50 A
Load angular rate	-1÷1 rad/s
Load angular acceleration	-1÷1 rad/s^2
Rotation reference bandwidth	4 Hz
Perturbing torque applied to the load: • low frequency (amplitude) • high frequency: a) frequency power spectrum b) r.m.s.	 -100÷100 Nm 0.5 Hz 8 Nm
Positioning error: • point-to-point operating mode • tracking operating mode	 1 mrad 1 mrad

Operating Modes

POINT-TO-POINT



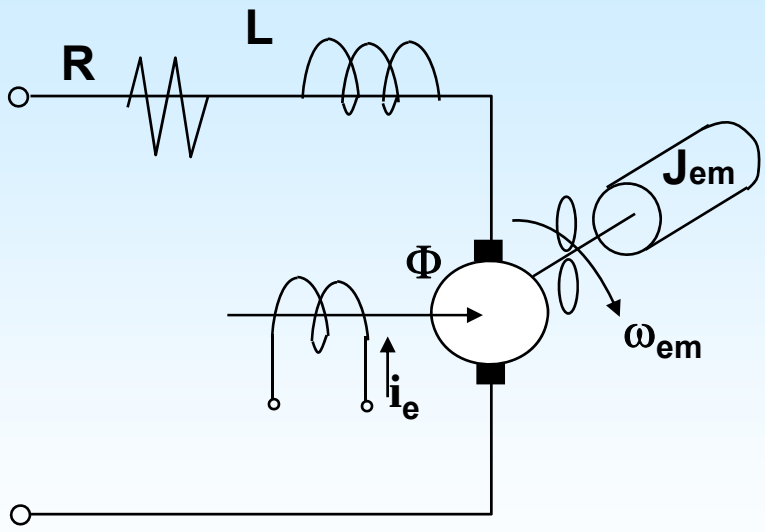


TRACKING

DEMO

Welcome to Innovation

Electric Motor Characteristics



Data Sheet Parameters

P = 220 W

T = 0.70 Nm

I = 12 A

I_{max} = 50 A

ω_{max} = 314 rad/s

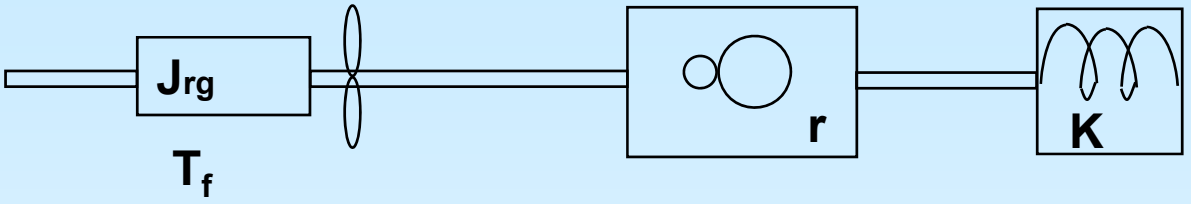
Φ = 0.059 Nm/A

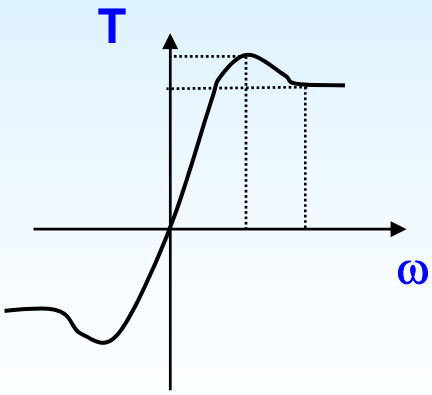
J_{em} = 1.5 10^{-4} Kg m^2

f_{visc} = 0.0003 Nms/rad

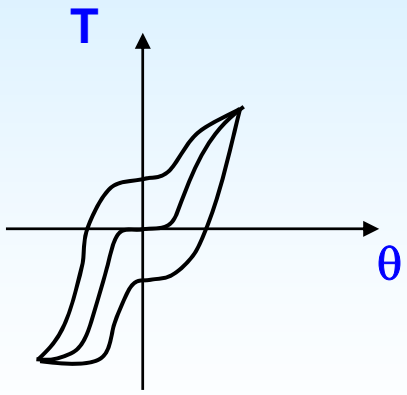
T_{stat} = 0.01 Nm

Reduction Gear Characteristics





Coulomb Friction Torque



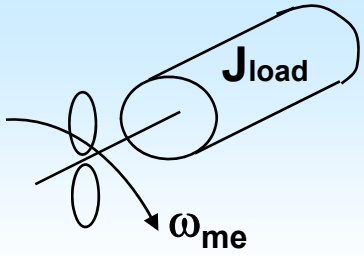
Backlash and Hysteresis Cycle

Data Sheet Parameters

- $r = 200$
- $T_{max} = 114$ Nm
- $J_{rg} = 1.94\ 10^{-4}$ Kg m^2
- backlash = ± 0.0025 rad
- K = 81870 Nm/rad

DEMO

Load Characteristics



Data Sheet Parameters

$J_{load} = 5\ Kg\ m^2$

Encoders Characteristics

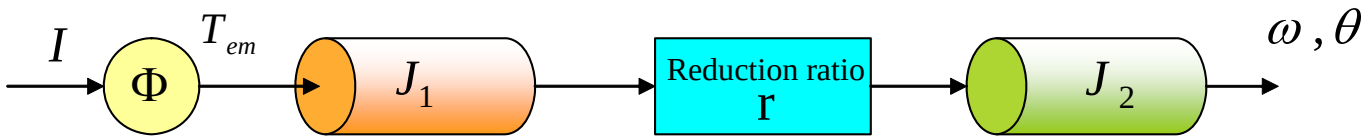
Encoder 1 Data Sheet Parameters

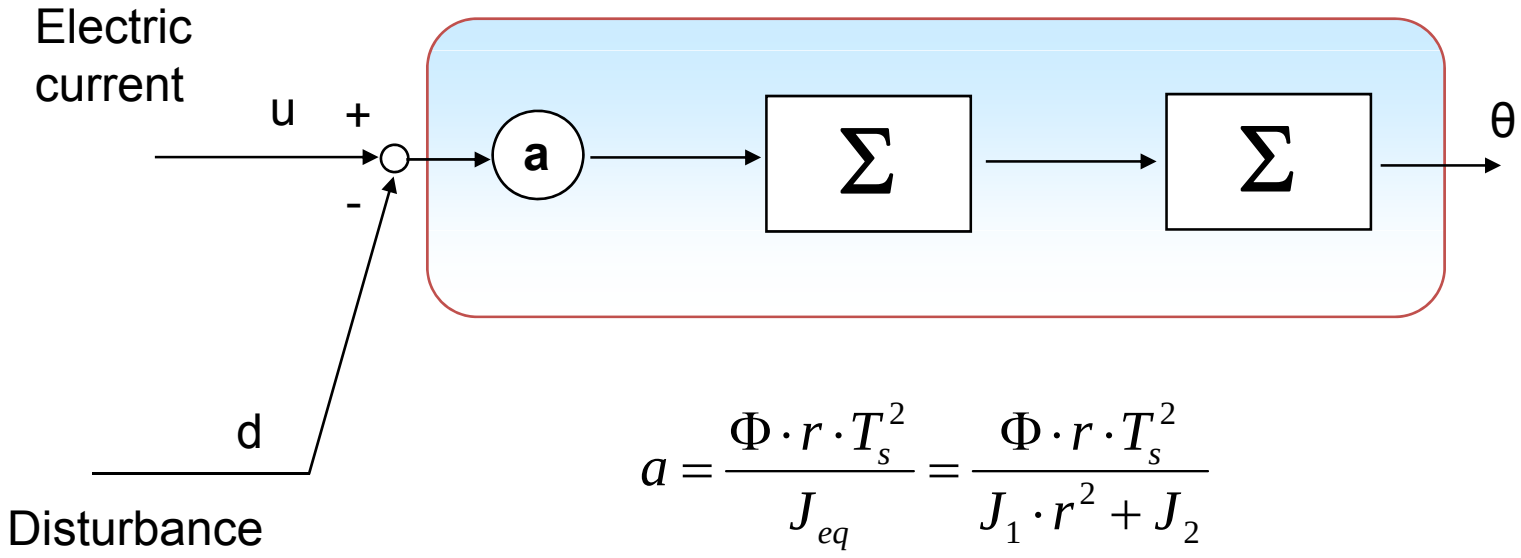
Quantisation level = 2 mrad

Encoder 2 Data Sheet Parameters

Quantisation level = 0.1 mrad

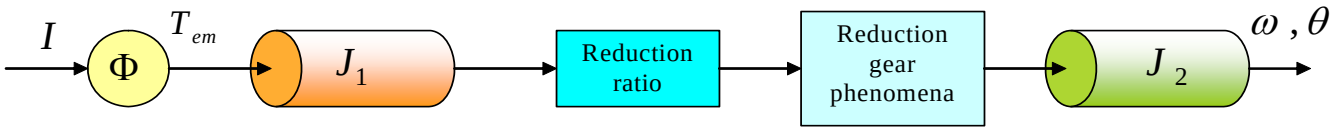
Plant Simplified Model

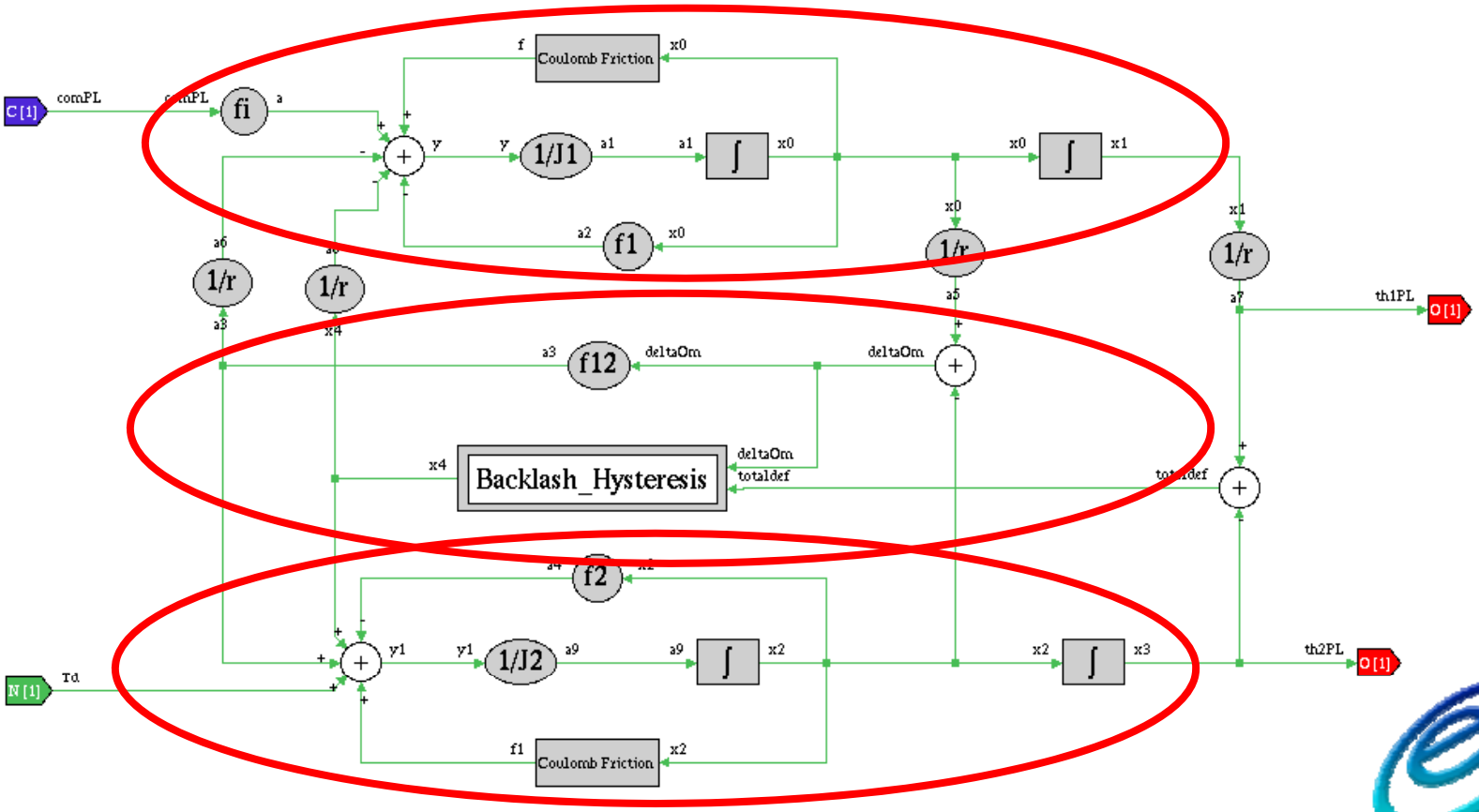




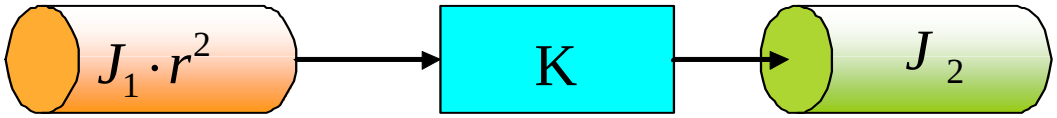
$$a = \frac{\Phi \cdot r \cdot T_s^2}{J_{eq}} = \frac{\Phi \cdot r \cdot T_s^2}{J_1 \cdot r^2 + J_2}$$

Fine Model


I
Φ
T_{em}
J_1
Reduction ratio
Reduction gear phenomena
J_2
ω , θ


C [1]
comPL
fi
f
Coulomb Friction
x0
a
y
1/J1
a1
x1
a2
f1
a6
1/r
a8
a5
a7
th1PL
O [1]
a3
f12
deltaOm
x4
Backlash_Hysteresis
totaldef
f2
y1
1/J2
a9
x2
x3
th2PL
N [1]
Td
f1

Frequency Band Limit



Frequency of the oscillations due to the elasticity of the system:

$$f_{bl} = \frac{1}{2\pi}\sqrt{\frac{K}{J_1 \cdot r^2 \oplus J_2}} \cong 24Hz$$

where: $J_1 \cdot r^2 \oplus J_2 = \dfrac{1}{\dfrac{1}{J_1 \cdot r^2} + \dfrac{1}{J_2}}$

with: $\begin{cases} J_1 = J_{em} + J_{rg} \\ J_2 = J_{load} \end{cases}$

Control Structures

DEMO

Control Algorithms

- *PID*;
- *Classical Model Based*, based on state observer and state control;
- *EICAS Model Based*, based on the EICAS control design methodology (www.eicas.it);
- *User*, where the user can develop a custom control algorithm.

Control Architectures

- Measure of the motor angular position;
- Measure of the rotating table angular position;
- Measures of both motor angular position and rotating table angular position (hierarchical control).

Performance Comparison

DEMO

Positioning error in the "point-to-point" operating mode

Control Algorithm	Mean squared value (mrad)	Control Architecture	Open loop command	Numerical Optimisation
PID	1.08	Load Measure	YES	YES
Classical Model Based	2.59	Load Measure	YES	YES
EICAS Model Based	0.78	Load Measure	YES	NO
EICAS Model Based	0.37	Hierarchical	YES	NO

Tracking error in the "tracking" operating mode

Control Algorithm	Mean squared value (mrad)	Control Architecture	Open loop command	Numerical Optimisation
PID	1.71	Load Measure	YES	YES
Classical Model Based	3.82	Load Measure	YES	YES
EICAS Model Based	1.18	Load Measure	YES	NO
EICAS Model Based	0.61	Hierarchical	YES	NO

EICASLAB DEMO is downloadable from: http://www.eicaslab.com/demo.htm

EICASLAB DEMO is

free of charge!

For info, please contact:
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