ingenero 360AI

controllerX360

Control loop performance diagnosis for every controller in the plant.

MODULE OF THE INGENEROX360 AI SUITE

PRODUCT OVERVIEW

controllerX360 is a vendor-agnostic control-loop performance monitoring application. It reads PV, SP, OP and MODE for every controller from the unit's own historian and passes each one through a cascading diagnostic tree — data quality, service factor, saturation, stiction, oscillation, sluggish tuning — so that a mechanical or operational fault is isolated *before* any tuning advice is given. No verdict rests on a single test: stiction, the hardest call to make, is confirmed only when four independent detectors agree. The output is not another list of alarms but a ranked, evidence-backed work list — which loops, what is wrong, and who owns the fix. Every threshold is normalised to the configured PV range, so a 180 t/h flow loop and a 1 mol% purity analyser are held to the same standard.

01 Unit Configuration

Shown: the five-step configuration wizard, the controller register and the active rule profile.

01	02	03	04	05
Know your unit	**Controller register**	**Diagnostic agents**	**Rules & thresholds**	**Review & run**
Historian, window, scan rate	PV / SP / OP / MODE tags	Engage per stage and method	Gates, modes, exclusions	Readiness, then execute
Configured	50 of 50	7 of 7	Validated	Ready

TAG	SERVICE	TYPE	UOM	RANGE	CONSEQUENCE	USE
15FC306	Ethylene rundown flow	FC	Kg/Hr	0 – 42 000	Critical	✓
15TC401	C2 splitter tray-42 temp	TC	degC	−40 – 10	Critical	✓
15PC602	Deethaniser pressure	PC	Kg/cm²	0 – 30	High	✓

ACTIVE RULE PROFILE

GATE	VALUE	BASIS
Service factor floor	85 %	AUTO + CAS + RCAS
Saturation dwell	30 %	samples at a limit
Stiction consensus	40 / 70	watch / confirmed
Hägglund regularity	0.60	zero-crossing spread
Harris index floor	0.30	vs minimum variance

Register — every controller with its tag map, range and consequence class. **Agents** — engage or disengage any stage, down to the individual stiction method. **Historian** — plug and play with PI, PHD, Exaquantum or IP.21, or an Excel upload. **Exclusions** — suppress a detection per loop where the behaviour is known and accepted.

02 Diagnosis and Prioritisation

Shown: a 50-loop ethylene fractionator benchmark — the verdict set, and where each gate catches its loops.

THE SIX PROBLEM TYPES — AND ONE CLEAN VERDICT

- **Low service factor** 14% — Abandoned by the operators — nothing below it can be trusted.
- **Saturation** 8% — Output pinned at a limit — a capacity fault, never a tuning one.
- **Stiction** 8% — Stem friction, four methods agreeing — the valve needs work.
- **Oscillation — aggressive** 12% — PV and OP both cycle — the controller drives it.
- **Oscillation — external** 8% — PV cycles, OP barely moves — the source is upstream.
- **Sluggish** 10% — Stable but far from minimum variance — recovery is slow.
- **Healthy** 40% — Passed every gate — PID parameters match the process dynamics; kept on the benchmark so drift is caught early.

HOW IT WORKS — THE DIAGNOSTIC CASCADE

	GATE	FC	TC	LC	PC	AC	CAUGHT	LEFT
1	Service factor	1	3	·	3	·	7	43
2	Saturation	2	2	·	·	·	4	39
3	Stiction	1	1	1	1	·	4	35
4	Oscillation	5	·	1	1	3	10	25
5	Sluggish	2	1	2	·	·	5	20
	Healthy	7	3	5	3	2	20	40%

Controllers caught 0 → 5+ — FC flow · TC temp · LC level · PC press · AC analyser

Why the order matters. Filtering operational state first keeps the classifiers from telling you to "reduce the gain" on a loop that is in MAN, pinned at a limit or stuck.

03 AI-Powered, Industry-Standard Methods

Four independent stiction detectors that must agree before the call is made, plus two benchmarks that grade the tuning.

Heuristic	OP ramps while PV stays still, then jumps — as an engineer reads it.
Horch cross-correlation	Time-delay asymmetry: separates stiction from aggressive tuning.
Yamashita phase plot	PV against OP: a line is a free valve, a parallelogram is stiction.
Choudhury bicoherence	Higher-order frequency statistics, robust to Gaussian noise.
Harris index	Grades loop variance against the minimum-variance benchmark.
Autocorrelation	Error autocorrelation and zero-crossing rate confirm a real cycle.

APPLIED ACROSS INDUSTRIES

- Petrochemicals
- Refining
- Power and utilities
- Metals and mining
- Specialty chemicals
- Pharma and life sciences
- Fertilizers, agrochem
- Pulp, paper, cement

Any plant with time-stamped PV / SP / OP / MODE data. The same gates and consensus logic transfer site to site — only the controller register changes.

04 Operator Experience

Controller-level detail: the evidence behind a verdict, and the ranked work list it produces.

VALVE STICTION — DEETHANISER COLUMN PRESSURE



CONFIRMED STICTION → VALVE WORK

4 of 4 methods agree · S ≈ 4.2 % OP · J ≈ 1.2 % OP · the phase plot reads as a parallelogram

WHAT THE TEAM RECEIVES — RANKED WORK LIST

#	CONTROLLER	DIAGNOSIS	HEALTH	ACTION & OWNER
1	15TC401	Saturation	12	Process intervention — *do not re-tune*
2	15FC318	Stiction	28	Valve shop — repack / positioner
3	15PC602	Stiction	29	Valve shop — repack / positioner
4	15FC310	Loop in MAN	37	Operations — re-qualify the loop
5	15FC301	Aggressive tuning	31	Control engineering — reduce gain

Ranked by consequence × severity — each row carries its evidence, the metric that fired and the owner of the fix.

05 Business Impact

What a correctly ordered diagnosis is worth to the operation.

- **100 % loop coverage** — Every controller, not a sample.
- **4 of 4 method consensus** — Four detectors must agree.
- **Zero false re-tunes** — Faults isolated first.
- **6 + 1 verdicts** — Six problem types plus healthy.
- **24×7 benchmarking** — Continuous or one-off.
- **One list every discipline** — One ranking, every discipline.

06 Platform

Runs inside your network; no data leaves the plant boundary.

- **Historian connectivity** — Plug and play with major historians.
- **Live or on demand** — Continuous or monthly runs.
- **Reporting** — Downloadable interactive reports.
- **Gen AI assistant** — Answers loop questions in context.
- **Build your own dashboard** — Engineers build their own views.
- **Quick setup** — Running within two weeks.

DELIVERY

Configured, validated and commissioned by Ingenero process and control engineers.

FLEXIBILITY

Any DCS, any historian, any loop type — thresholds and agents selectable per unit.

SCALE

Ten loops or ten thousand — the register is the only thing that changes between sites.

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