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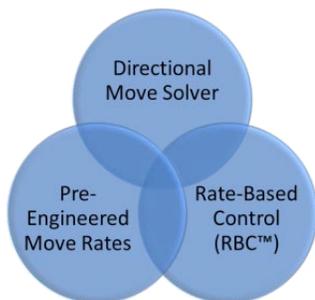
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XMC™: HIGH PERFORMANCE AND LOW COST

- XMC™ is a **model-less** multivariable control and optimization technology that overcomes the costs and complexities of model-based control.
- XMC™ delivers **high-performance**, with predictive and adaptive control algorithms, plus comprehensive features, to meet the needs of industry's demanding and diverse applications.
- XMC™ is **cost-effective**. Application cost is a fraction of model-based costs, and XMC™ can be deployed in a fraction of the time!
- XMC™ provides a **path forward**. It is scalable from conventional large-matrix applications to industry's many small-matrix applications that in the past could not justify the high costs.

XMC™ CONTROL THEORY

The XMC™ control algorithm comprises three components – a directional move solver, pre-engineered



move rates, and patent-pending Rate-Based Control (RBC™). These components work together to mimic the methods that expert operating teams have always employed to

manage and optimize multivariable processes. On a 24/7 basis!

XMC™ incorporates important and novel features to meet diverse application needs, such as dead-time control, integrator control, and super-position control.

Read more at Lin & Associates.com.

XMC™ SAVES (and EARNS) \$100Ks

XMC™ application cost is *an order of magnitude less* than model-based costs. And as a more robust technology, XMC™ can more reliably capture the benefits of multivariable control, such as improved throughput, yield, quality, and energy efficiency.

Life-cycle savings increase the value of XMC™ further, with no unwanted maintenance, support or model-based performance monitoring costs.

XMC™ IS OPERATION-FRIENDLY

XMC™ is designed to be deployed by in-house operating and engineering teams, on existing control system platforms, in time frames of days or weeks, not months.

XMC™ applications are framed as matrices of direct-control variables (DCVs) and indirect-control variables (ICVs). XMC™ incorporates many new and novel concepts, but also builds on industry's foundational experience and prior investments in multivariable control technology.

This makes adopting XMC™ is natural and intuitive. It eases the historical difficulties of multivariable control ownership, while improving results and reducing costs.

TURN THE PAGE TO LEARN MORE ABOUT . . .

- XMC™ Control Theory and Features
- Multivariable Control at a Crossroads
- The power and ease of adopting XMC™
- Request an XMC™ evaluation controller

XMC™ CONTROL THEORY

The XMC™ control algorithm comprises three components:

- A directional move solver
- Pre-engineered DCV move rates
- Rate-Based Control (RBC™) (patent-pending)

The directional move solver determines, for each DCV, whether a positive or negative move is indicated, based on related ICV constraint limits, optimization targets, and the gain-direction of each DCV-ICV interaction. The move solver does not calculate *total* move size, but only whether a positive or negative *directional* move is indicated.

In XMC™, DCV move rate is a pre-configured engineering parameter, rather than being calculated within the controller. The appropriate move rate for each DCV is pre-selected based on engineering and operating criteria, and on existing operating knowledge, practice and procedures. The base move rate can be modified when necessary, using move multipliers and optimization speed factors.

Rate-Based Control (RBC™) determines when to reduce or stop the DCV moves based on the approach rate of ICVs to constraint limits and optimization targets. This method is computationally less complex and more robust than traditional model-based calculation methods, and has several unique and advantageous control performance characteristics. In particular, RBC™ is inherently predictive and adaptive in real-time with regard to changes in process gain, which has been a particular vulnerability of model-based multivariable control solutions.

RBC™ *control performance* is also unaffected by changes in move size, which makes tuning of move size, to satisfy *operational* criteria, a straight forward task.

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XMC™ FEATURES

XMC™ performance and convenience is enhanced by a full complement of the features industry has come to expect in multivariable control solutions, such as:

- Dead-time control. Industry lacks a ready solution for dead-time control applications. An XMC™ solution can be deployed in minutes, or embedded within a larger matrix application.
- Super-position control (SPC) accomplishes two objectives at once, such as heater pass balancing *and* total flow control, which eliminates troublesome bias/gain blocks and “bumpless” initialization concerns.

			PASS1 DT	PASS2 DT	PASS3 DT	PASS4 DT	TOTAL FLOW
XMC ON/OFF:		1					
MSG NUM:		0 0 0	0.1	-0.1	-0.0	-0.0	80.0
MSG TEXT:		NONE					
SAS STATUS:		0	1 1	0 1	1 1	-0.0 1 1	-0.0 1 0
DCV CONFLICT:		0	10.0	10.0	10.0	10.0	100.0
NUMDCVs:		4	0.0	0.0	0.0	0.0	80.0
NUMICVs:		6	-10.0	-10.0	-10.0	-10.0	25.0
OFL	CON	PASS 1					
	OPT	0.012	18.7	-1	0	0	0
●	OPT	0.012	18.7	OPT	OPT	OPT	OPT
	OPT	0.012	18.7	0	0	0	0
●	CON	PASS 2					
	OPT	-0.008	21.3	0	-1	0	0
●	OPT	-0.008	21.3	OPT	OPT	OPT	OPT
	OPT	-0.008	21.3	0	0	0	0
●	CON	PASS 3					
	OPT	0.002	16.2	0	0	-1	0
●	OPT	0.002	16.2	OPT	OPT	OPT	OPT
	OPT	0.002	16.2	0	0	0	0
●	CON	PASS 4					
	OPT	0.001	23.7	0	0	0	-1
●	OPT	0.001	23.7	OPT	OPT	OPT	OPT
	OPT	0.001	23.7	0	0	0	0

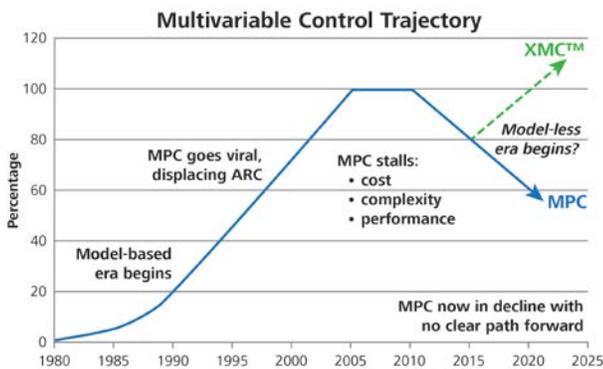
Engineer view of an XMC™ pass-balancing application with total flow SPC.

- ICV Limit Biases can be configured so that DCVs act *in succession*, the way operations often prefers, without the need for extra, often confusing, calculated ICVs.
- ICV Move Multipliers and Overrides allow move rates for individual DCV-ICV pairs to be tailored to meet specific process and operating needs when necessary.
- Feedforward ICVs incorporate key disturbance variable information, making XMC™ fully predictive in both the model-based and the rate-based sense.

Request the [XMC™ Engineering Manual](#) to read more.

MULTIVARIABLE CONTROL AT A CROSSROADS

For nearly three decades, model-based multivariable control (MPC) has been the dominant goal of advanced process control practice. But MPC's high cost, complex ownership, and tendency to low performance, have never resolved themselves. Today, MPC activity in industry is in decline.



This leaves a critical vacuum in the process control and automation field. MPC in the past has involved controllers costing hundreds of thousands of dollars and matrices involving hundreds of models, so that multivariable control is often viewed as a technology with limited application. But nearly all processes, big and small, from entire distillation trains to individual columns, are multivariable by nature, and require automated multivariable control for effective operation, constraint control and optimization.

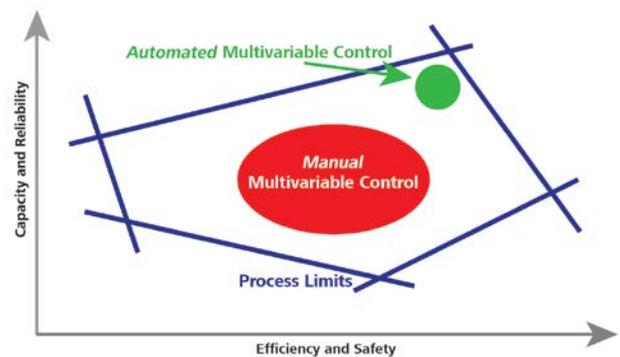
Industry has not been satisfied with “big matrix” MPC, it's been expecting it to become more scalable, affordable and agile. Today, with MPC activity in decline and its limitations appearing structural, industry is left holding its existing big matrix applications, and facing its numerous small-matrix applications, empty handed. XMC™ offers a path forward.

XMC™ PROVIDES A PATH FORWARD

XMC™ is a model-less matrix control and optimization technology that offers industry a path forward. A model-less approach can be perceived as problematic in the model-based era, but experience has shown the opposite to often be the case. Excessive dependence on inherently unreliable models has been identified as a root cause of low model-based performance, and models are certainly at the root of continued high cost and complexity. A model-less approach dispenses with the difficulties associated with detailed models, and instead mirrors the methods operating teams having always employed for effective process constraint management and optimization, with the added benefit of automation.

GOOD-BYE TO COSTS, WELCOME TO PERFORMANCE

By eliminating dependence on models, XMC™ becomes simpler, less expensive and more reliable, at every life cycle stage. Many steps, such model performance monitoring and re-modeling, disappear entirely.



Almost all processes are multivariable in nature and require multivariable controllers for effective real-time constraint management and optimization.

XMC™ algorithms and features are designed to deliver performance and reliability with convenience and agility.

Going forward, XMC™ offers industry a cost-effective, off-the-shelf, owner-friendly solution – just in time!

BRIDGING THE GAP TO XMC™

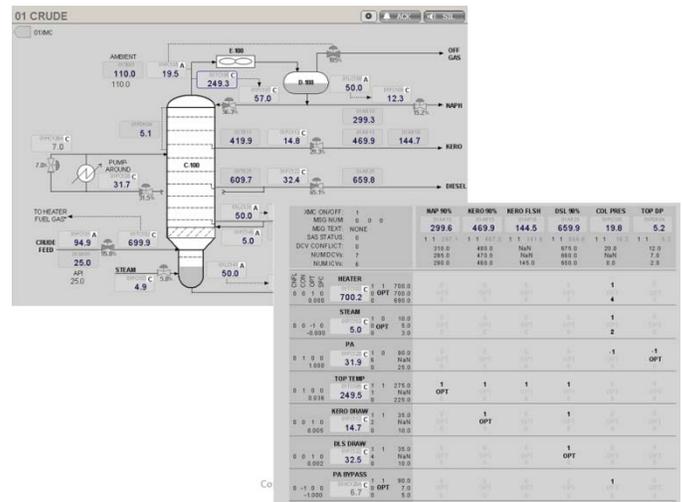
XMC™ runs natively on DCS control systems and is designed to be supported by a customer's *in-house* control engineers. XMC™ technology is easily mastered, so that support and application design soon become second nature. XMC™ empowers, rather than consumes, in-house control engineering resources.

To bridge the initial skill gap of getting started with XMC™, L&A offers the following services:

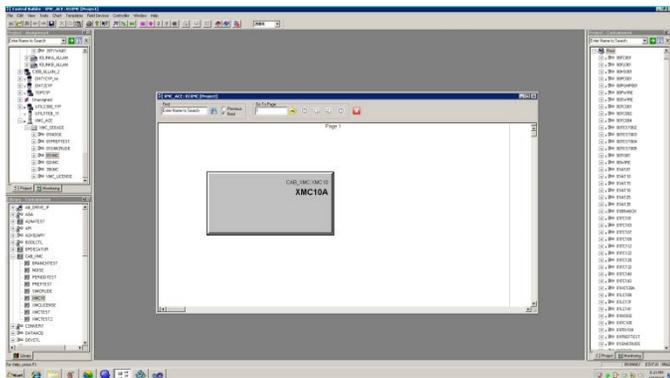
- Email support is available by registering on the L&A website. Ask any question!
- A 3-day training course of XMC™ theory and practice, for control and process engineers.
- Consulting services to assist in defining and deploying initial applications.
- An XMC™ evaluation controller, to test, train, and develop XMC™ applications.

REQUEST AN XMC™ EVALUATION CONTROLLER

For a limited time, Lin & Associates is offering a no-cost XMC™ license in conjunction with the purchase of consulting and training services. One week of services includes training and installation of an XMC™ evaluation controller.



A simulated crude distillation unit and associated XMC™ controller, available to customers for evaluation.



On a Honeywell Experion ACE-CAB platform, XMC™ is deployed as a single importable function block.

XMC™ AVAILABLE PLATFORMS

- Honeywell Experion PKS ACE/CAB
- Honeywell TPS Application Module AM/CL

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XMC™ RETURN ON INVESTMENT (ROI)

XMC™ applications cost an order of magnitude less than traditional multivariable controller costs, so that XMC™ ROIs are an order of magnitude shorter, such as one month, rather than one year.

Alternatively, customers can evaluate XMC™ by initially targeting smaller scale applications, such as individual distillation columns. These applications typically cost, and earn, on the order of tens of thousands of dollars, with a typical ROI of one year.