General Specifications

GS 36J06D20-01E

NTPS420
Exarqe
Robust Quality Estimator
Overview

■ GENERAL

The process control industry has been continuously shifting the focus away from controlling intermediate variables, namely Flow, Temperature, Level and Pressure to the final product qualities. The advances made in Advanced Process Control, especially Model Based Predictive control have overcome the problems in quality control loop such as process interactions, and large time delay. However, there are still many quality control loops not closed because of the lack of reliable product quality measurement.

The Robust Quality Estimator is a software package designed to provide product quality signal as feedback to Advanced Process Control applications. It has been widely applied in Refineries and Petrochemicals processes. For example, the package has been successfully applied to infer the following properties:

Polymer Melt Index,
4CBA in Terephthalic Acid (TA),
Kerosene Flash Point,
Total aromatics in Platformate,
Light Naphtha RVP,
Light Cycle Oil 90% distillation point, etc.

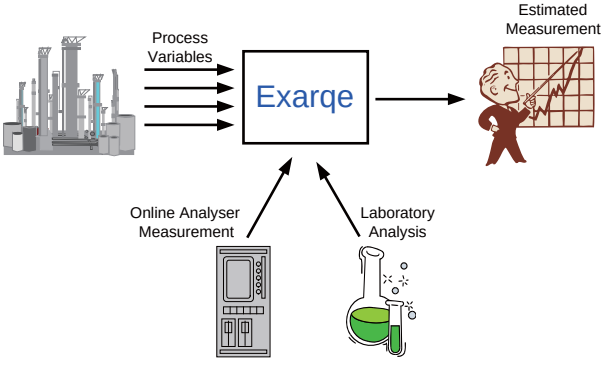
■ FUNCTION SPECIFICATION

The equation below shows the general form of a quality estimator model.

QE = f(T,F,P,,,)
f: linear or non-linear, static or dynamaic

For example,

iC5 = C1 x Top_Temp + C2 x Top_Press + C3



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Exarqe outline

Quality Estimation Technology – RQE model estimation technology provides methods for determining linear and nonlinear, static and dynamic, process models.

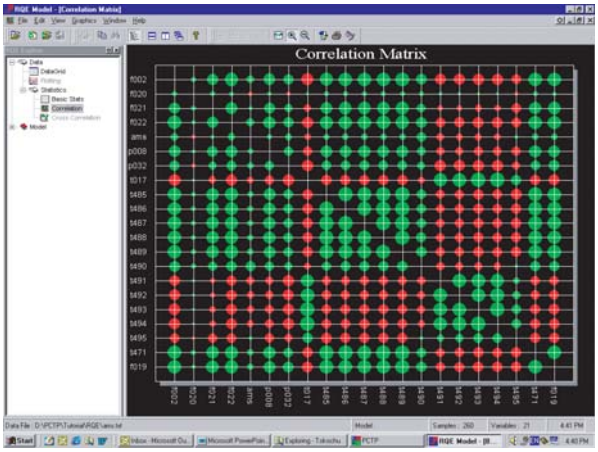
RQE provides for explicit estimation of dynamics between the candidate inputs and the targeted output using the following modeling methods.

- Multiple Linear Regression (MLR)
- Principal Component Regression (PCR)
- Partial Least Squares (PLS)
- Radial Basis Function (RBF)

RQE provides statistical 95 percent confidence intervals for the estimated dynamics. RQE uses efficient, state-of-the-art numerical computational solutions that permit solving large identification problems in minimal time.

Trending – Enhanced and flexible trending capabilities such as stacked and shared plotting axes, zooming, auto-scaling, manual scaling, common scaling, scrolling, color customization, easy tag rearrangement, tag trend locking, easy data value access from trends, data segmentation, and slicing of bad data from trends.

Correlation Analysis – The static relationship between measurements is displayed in a graphic matrix form. This helps identify candidate inputs to explain the variation in the targeted output, and also helps, in combination with engineering knowledge of the process, if the data set includes enough excitation for a successful modeling effort.



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Correlation Analysis

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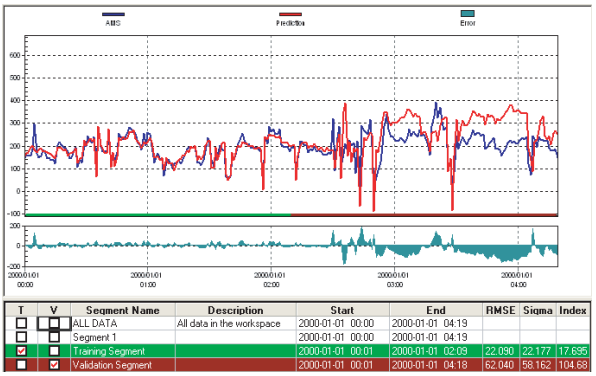

T	V	Segment Name	Description	Start	End	RMSE	Sigma	Index
☐	☐	ALL DATA	All data in the workspace	2000-01-01 00:00	2000-01-01 04:19			
☐	☐	Segment 1		2000-01-01 00:00	2000-01-01 04:19			
☑	☐	Training Segment		2000-01-01 00:01	2000-01-01 02:09	22.090	22.177	17.695
☐	☑	Validation Segment		2000-01-01 00:01	2000-01-01 04:18	62.040	58.162	104.68

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Model fitting

Simulation
Offline simulation function is provided for process engineers to tune RQE model. It reads the RQE model and test data from the offline environment. Simulation models and scenarios are generated and the test results are also saved on the offline environment. More than one RQE applications are tested in the same environment.

■ GENERAL CONFIGURATION

● Features

- Extensive online analyzer signal checking, including out of-range handling, frozen value detection and spike rejection.
- Operator lab interface with entry consequence preview. Prediction calculation and output processing (clamping, asymmetrical filtering)
- Full model updating using Kalman filtering (either on basis of online analyzer or on basis of laboratory results)
- Handling of non-linear qualities either via non-linear Neural Network type model, or via built-in configurable characterizer functions.
- Input checking of reference laboratory result prior to model prediction update.
- SPC techniques, including score card, CUSUM, and spike rejection.
- Internal steady state detection.
- Robust handling of uncertain and varying delay of the quality reference measurement.
- Upgraded Web-based Human Interface.
- PCTP (Exarqe offline) and Exarqe online operate in Windows 7/Vista/2003/2008 environments.

● Application

Multiple models in a single model
Exarqe applications consist of multiple Exarqe predictions. A multiple model performs much systematic estimation. For example, it is effective in the following applications.

- Multiple oil blend models.
- Combination of online analysis model and lab analysis model.
- Outlet quality estimation which has intermediate quality model in input.
- Series reactor quality estimation which connected each reactor model.

Blending application
Exarqe can perform blending calculations on a volume or mass basis. The method used depends on the blender configuration. Blend calculations start when the blend start flag is set and stop when the flag is reset.

The system also needs to ensure that the tank heel quantity, tank heel properties, blend compensation quantity (if TQC is used), and blend planned volume (if TQC is used) are stored in the designated tags, and that the tank integrated inlet and outlet flows are initialized to zero, at the start of the blend.

Exarqe calculates the tank quality estimate (TQE) starting from the tank heel quality and adds in the effect of the quantity of material added to the tank since its last execution (as indicated by the change in integrated inlet flow) and removing the effect of the quantity of material leaving the tank since the last execution (as indicated by the change in integrated outlet flow). The tank calculations are performed as two-component blending calculations, with one component being the material already in the tank and the other component being the material added to the tank on this execution. (The material leaving the tank affects the quantity in the tank but not the quality since the tank is assumed to be well mixed.) The calculation begins with the first good instantaneous quality prediction after blend initialization.

Lab Data and online Analyzer input checking
Exarqe model and its predictions need to be constantly updated based on feedback. This feedback is normally, from lab data or online analyzer. Before Exarqe goes into the step of updating, the feedback data itself is verified.

Model Update
One way of making an estimator robust is to let the model learn from feedback. In case of quality estimator, the problem is peculiar since feedback comes with a delay. The way in which the estimator handles this delay will make it robust.

OPC interface / Integration tool
Exarqe can connect to any DCS or PLC via OPC interface to communicate with process input and output data.

Device mode/Cache mode is selectable. Error processing according to the type of OPC error is prepared.

Integration function is also provided with to exchange data between Exasmoc controller and Exarqe estimator, between Exarqe estimator and any OPC server.

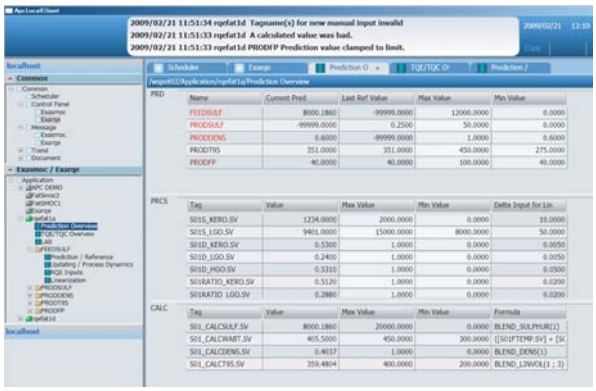
Calculation function
Using the input data of Integration tool, the calculation function executes the predefined calculation and outputs the results to the OPC server via Integration tool. Basic calculation (add/subtract/multiply/divide), arithmetic calculation (Sine/Cosine/Tangent/ArcTan/ Log/Absolute/...), filtering, logical operation and so on are provided with. Builder function and test function are also prepared to make it easy to implement it.

■ HMI CONFIGURAION

Human interface is fully upgraded from R4, which consists of Web-based style views. Each view is available not only in HIS, APC client but also Web PC via Web server.

- Overview
- Engineering view
- Lab Entry view
- Trend view
- Scheduler view
- Tree –view and multi-screen

Note) R4 APC client function is available from VP HIS.



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Overview

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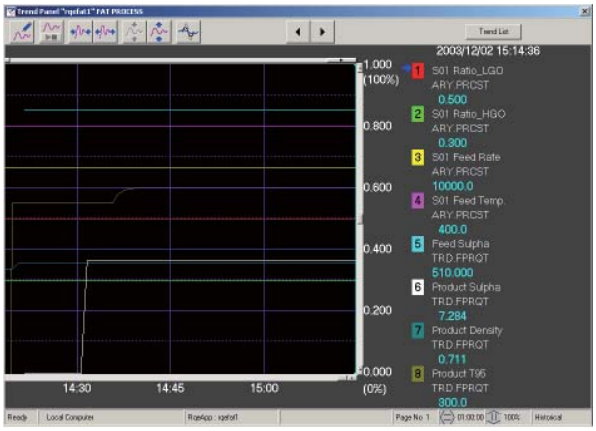
Engineering view



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Trend view

■ SYSTEM CONFIGURATION

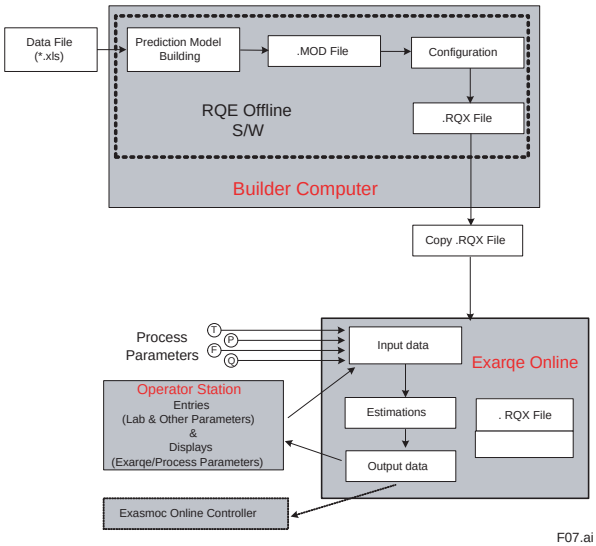
The Exarqe consists of two portions, offline for data analysis and model design and online portion of real-time implementation.

Offline

Exarqe offline function is to design the RQE model, perform simulation and builder the Exarqe estimator.

Online

Exarqe online function is to periodically read process information from the DCS, estimate the quality with the model and download the results to the DCS or APC system. It also includes the update mechanism using feedback from either online analyzer or laboratory results.



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Exarqe configuration

■ SYSTEM CONFIGURATION

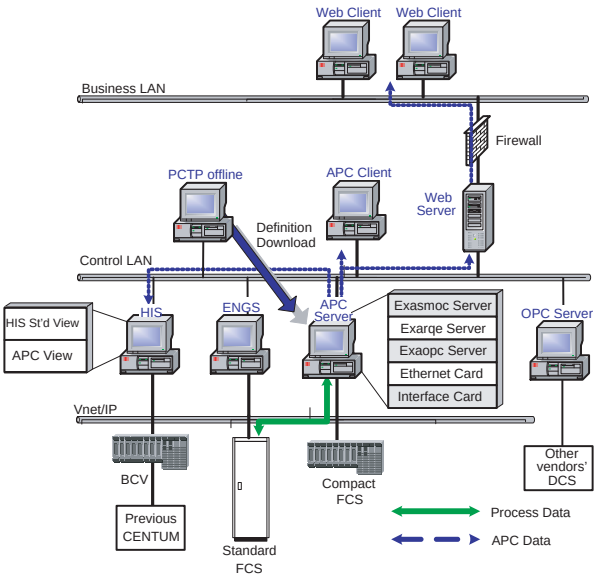
Exarqe can connect to variety of DCSs and control systems. It reads the process data, performs the control action and writes the control outputs. All information is possible to access from HMI stations. APC function consists of the following stations:

- APC server: Exasmoc/Exarqe/Exaitg control execution.
- APC client : APC HMI interface
- Web server: Web server for APC HMI
- Web client : Web client function

APC station as well as HIS equalizes engineering data from the ENG engineering station of the CENTUM system.

CENTUM VP System

APC station is connected to control stations via the VI/VF Control Bus Interface Card, and it reads/writes tag data and receives process messages.



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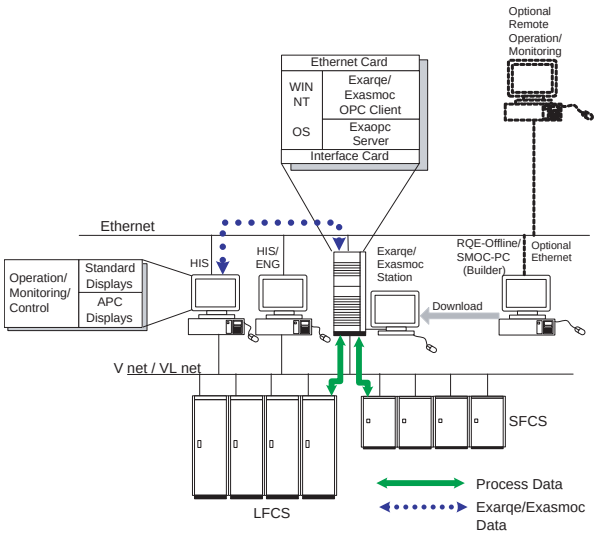
CENTUM CS 3000 System



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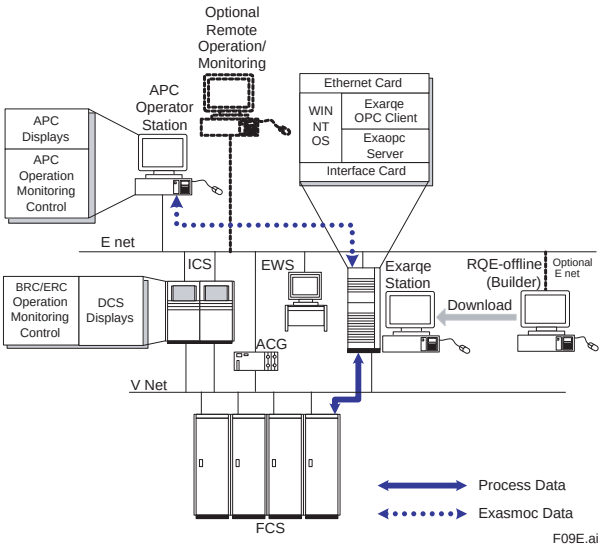
CENTUM CS System



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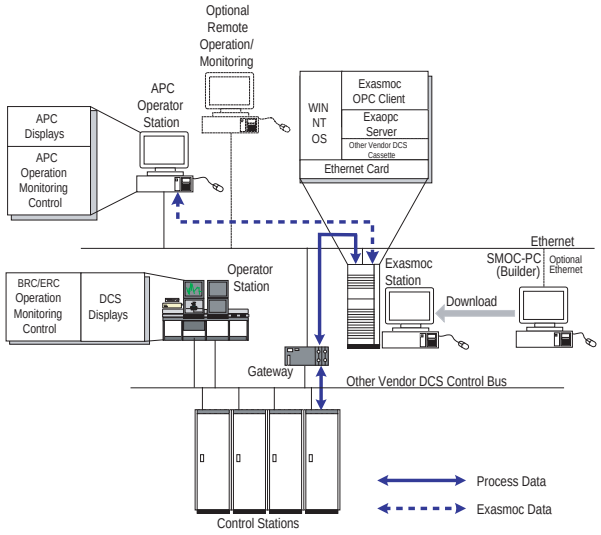
Other vendor DCS System

The Exarqe station is connected to other vendors' DCS via OPC interface and Ethernet.

Connection test between Exarqe with other vendor's DCS is indispensable in advance.



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■ APPLICATION CAPACITY

Max. number of Exarqe application: 20
Max. number of prediction: 20 per 1 application
The period of the Exarqe estimator: The value should be specified 60 seconds or more.
The state of the Exarqe estimator: ON or OFF.
The name of the Exarqe Estimator: Up to 10 characters.

■ OPERATING ENVIRONMENT

Hardware

(APC server function)

CPU: Core 2 Duo 2.13 GHz or better
Main memory:
2 GByte or more (3 GByte recommended)
Disk capacity: 40 Gbyte or more recommended
Drive: DVD-ROM and CD-ROM drive
Monitor: SXGA (1280 x 1024 resolution), True Color
Mouse:
Communication device:
Ethernet-ready network card with 100 MBPS or more
VF/VI Control Bus Interface Card is required when connecting to CENTUM VP, CS 3000, CENTUM CS.
Graphics: DirectX 9 corresponding GPU and 128MB graphic memory

(APC client function)

CPU: Core 2 Duo 2.13 GHz or better
Main memory:
2 GByte or more (3 GByte recommended)
Disk capacity: 40 Gbyte or more recommended
Drive: DVD-ROM and CD-ROM drive
Monitor: SXGA (1280 x 1024 resolution), True Color
Mouse:
Communication device:
Ethernet-ready network card with 100 MBPS or more
Graphics: DirectX 9 corresponding GPU and 128MB graphic memory

(APC Web server function)

CPU: Core 2 Duo 2.13 GHz or better
Main memory:
2 GByte or more (3 GByte recommended)
Disk capacity: 60 Gbyte or more recommended
Drive: DVD-ROM and CD-ROM drive
Monitor: SXGA (1280 x 1024 resolution), True Color
Mouse:
Communication device:
Ethernet-ready network card with 100 MBPS or more
Graphics: DirectX 9 corresponding GPU and 128MB graphic memory

(APC Web client function)

CPU: Core 2 Duo 2.13 GHz or better
Main memory:
2 GByte or more (3 GByte recommended)
Disk capacity: -
Drive: -
Monitor: SXGA (1280 x 1024 resolution), True Color
Mouse:
Communication device:
Ethernet-ready network card with 100 MBPS or more
Graphics: DirectX 9 corresponding GPU and 128MB graphic memory

Software

OS: Windows Server 2008 R2 (SP1, 64 bits)
Windows Server 2008 (SP2, 32 bits)
Windows 7 (SP1, 64 bits)
Windows Vista (SP2, 32 bits)

Note: In Web server, Server2008 and 2008 R2 are available.

The Exarqe package and Windows must use the same language.

Others:
Internet Explorer 7.0/8.0/9.0
PCTP 2010 Build 1
Adobe Reader 10

Note: Exasmoc/Exarqe R4.03 APC client function is available from VP R5.01.00. In the previous HIS, R3.06 client (needs pre-test) and Web client are available.

Interface Package

Exaopc R2.01 or later is required.

Note: - Exaopc R3.72.00 is required when Exaopc is installed on the same PC as Exarqe.
- Exaopc is not available in Server 2008 up to now.

OPC Interface

OPC interface connected to Exarqe should support the following specification. Connection test in advance is recommended.

- OPC revision: Compliant to OPC Foundation specification.
- OPC DA 1.0a or later in case of single OPC server
  OPC DA 2.05a or later in case of multiple OPC server
- OPC function: Synchronous read/write, Asynchronous read/write
- OPC performance: 100 data read and write per every second

■ MODEL AND SUFFIX CODES

		Description
Model	NTPS420	Exarqe Robust Quality Estimator
Suffix Codes	-S1	Basic Software License (with Media) (*1)
	-S5	Site License for Small Site (with Media) (*2)
	-S6	Site License for Medium Site (with Media)
	-S7	Site License for Large Site (with Media)
	0	Without Exarqe online package (*3)
	1	With Exarqe online package
	1	Always 1
	1	English version
	-S9	Calculation function
Option Code	/☐-ADU	Software License for Additional Unit (1 to 7 units) (*4) ☐: 1 to 3 ☐: 4 to 7

*1. Basic software license includes 1 copy of offline RQE.
*2. Site license includes 3 copies of offline RQE.
Suffix Code “-S5”: Small Site; Less than 100,000 BPD Suffix Code “-S6”: Medium Site; 100,000 BPD to 199,999 BPD
Suffix Code “-S7”: Large Site; 200,000 BPD or larger
*3. At least one Exarqe online package has to be quoted per PC.
Exaopc package is required for Exarqe to interface with CENTUM CS 3000.
*4. The number of additional unit has to be entered in ☐ (i.e., enter “1” for the second unit).

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