

# Tai-Ji ID

## A New Generation MPC Identification Technology

### The Product

Tai-Ji ID is an MPC/APC identification software package that carries out identification automatically from test design to model validation. Tai-Ji ID is powered by modern identification technology that uses parametrical models, automated multivariable closed-loop test (open loop test is also possible) and new way of model validation. Tai-Ji ID works on Windows 98 and NT. Tai-Ji ID consists of two parts:

- 1) An off-line computation program Tai-Ji ID 3.2. First, it performs test design and generates test signals (move patterns) for identification test (step test). Then during and after the test, it performs model identification. Almost all the tasks are performed automatically. Time delays are estimated automatically.
- 2) An online test program Tai-Ji Test. It performs real-time test using the test signals designed by the off-line program. It has the interfaces to communicate with multi data sources such as CIMIO, OPC, PHD and others. It has GUI's for test monitoring and alarm functions.

### How does it Work?

After a pre-test of the unit, a user can use Tai-Ji ID to perform identification test and to identify process models using the testing data. The identification procedure consists of following steps:

- 1) Perform test design and generate test signals for MV's (and possibly some CV setpoints for closed-loop test). This is done using the offline program Tai-Ji ID 3.2.
- 2) Carry out test using Tai-Ji Test that implements the move patterns designed by the offline program. The test is automatic, but the user can always take manual control actions. The test is multivariable meaning that many or all MV's are moved simultaneously. The test can be in closed-loop operation, meaning that some (sensitive) CV's can be controlled by PID controllers or by an MPC controller. Any controller (PID, DMCplus, RMPCT,...) can be used during a Tai-Ji ID test and correlated MV moves are no problem for the technology.
- 3) During the test, load current test data to the offline program and perform model identification and validation. Based on the validation result, modify the ongoing test by changing the step sizes in order to obtain models with sufficient high qualities at the end of the test.
- 4) When all the expected models are with good quality according to model validation, stop the test and load the models to the MPC controller. Controller simulation and commissioning will follow.

### The Benefits

Tai-Ji ID technology has been applied successfully to over 100 industrial processes in MPC control projects (DMCplus, RMPCT) in refinery and petrochemical industries. The advantages of Tai-Ji ID technology are:

- 1) Improved model quality. Tai-Ji ID test method increases the information content in process data and Tai-Ji ID uses parametric models and disturbance models.
- 2) Reduced cost. Test time can be reduced by 70% (to test a crude unit MPC with 20 MV's will cost 5 days instead of 15 to 20 days) and data analysis and modelling time is reduced by over 80%.
- 3) Reduced disturbance to unit operation during plant tests. This is realised by using closed-loop test and encouraged operator control action.
- 4) User friendliness. Both the identification test and modelling steps are automated.

### Who Use Tai-Ji ID?

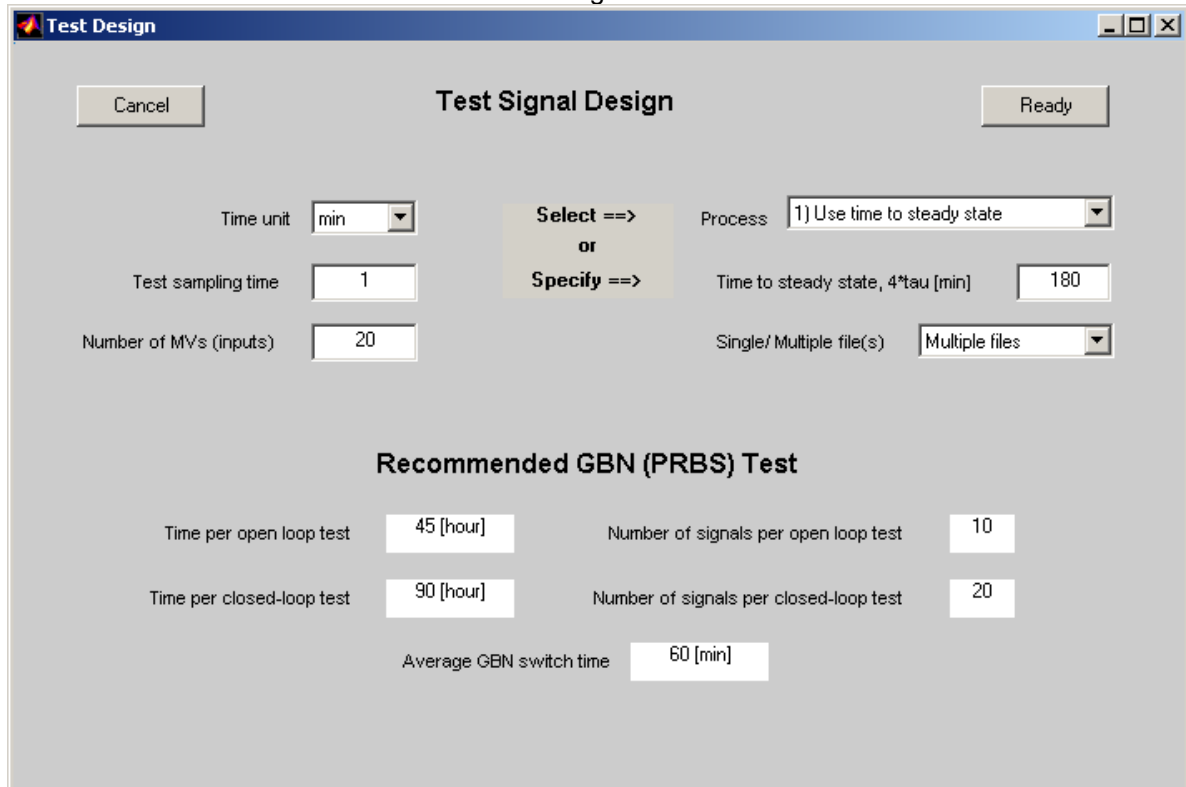
Dow Chemical (Netherlands, Germany, USA, Canada), Statoil (Norway, Denmark), Zhongkong (China), Air Products (USA), ExxonMobil (Worldwide), BP (Netherlands), Valero (USA), IFP (France), TotalFinaElf (France), CITGO (USA), PetroBras (Brazil)

### What Kind of Units?

FCCU, Delayed cokers, Crude units, CCR paltforming, Ethylene plants, Aromatics units, and more .....

## Some Windows of the Off-line Program

Test design window



**Test Design**

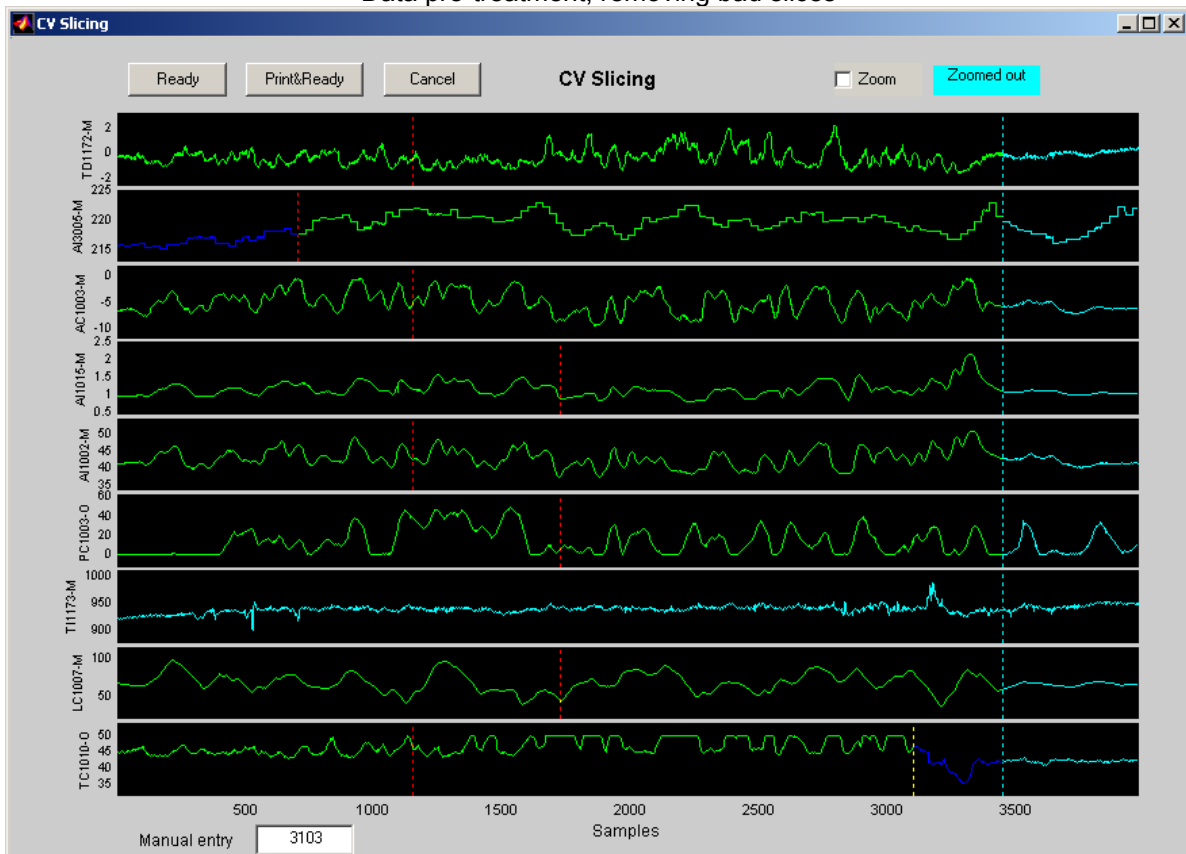
Cancel Ready

Time unit:  Select ==> Process:   
or  
Specify ==> Time to steady state, 4\*tau [min]:   
Test sampling time:  Single/ Multiple file(s):   
Number of MVs (inputs):

**Recommended GBN (PRBS) Test**

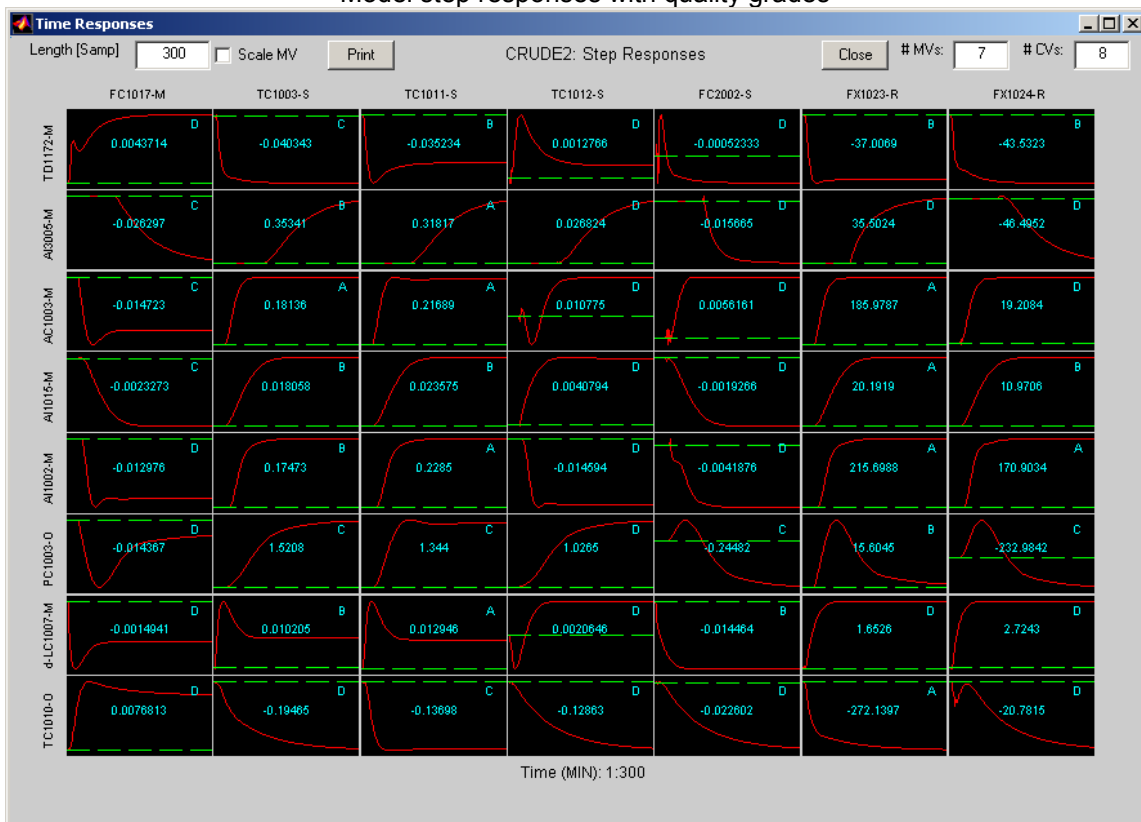
Time per open loop test:  Number of signals per open loop test:   
Time per closed-loop test:  Number of signals per closed-loop test:   
Average GBN switch time:

Data pre-treatment, removing bad slices

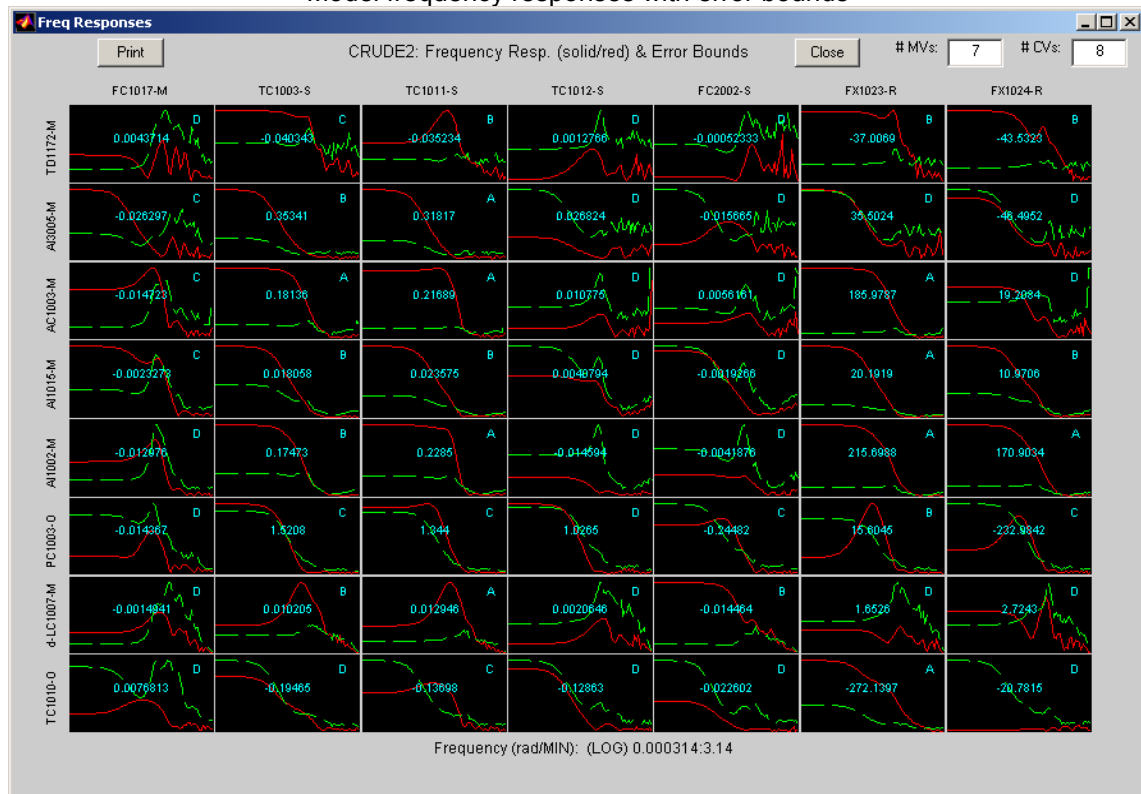


## Some Windows of the Off-line Program (Cont.)

Model step responses with quality grades



Model frequency responses with error bounds





### Some Windows of the Test Program

#### MV configuration

The screenshot shows the 'MV configuration' window. It features two plots at the top: 'MV 1' and 'MV 2'. Below the plots is a table with the following data:

	MV1	MV2	MV3	MV4
TagName	TaiJi_MV1.SP	TaiJi_MV2.SP	TaiJi_MV3.OP	TaiJi_MV4.SP
ON/OFF	1	1	1	1
Average	600	6.5	94.5	18.95
Amplitude	50	5	10	3
CurrentSP	980	10.5	120.2	18.95
CurrentPV	604.8045	7.500275	95.22289	15.27049
CurrentOP	42	53	94.5	82

On the right side, there is a 'Control Panel' with buttons for 'Load MV', 'Verify Read', 'Turn ON All MV', and 'Turn OFF All MV'. The 'Max MV No.' is set to 10.

#### CV Configuration

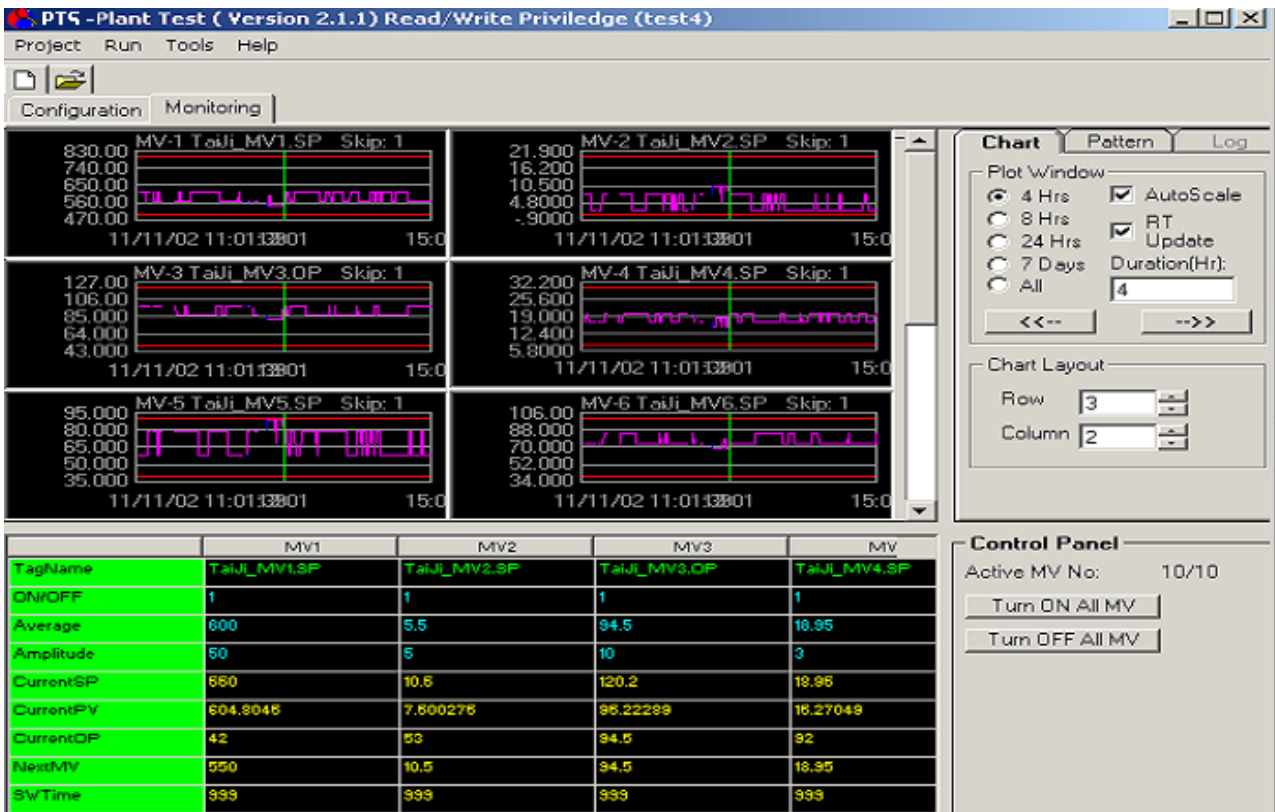
The screenshot shows the 'CV Configuration' window. It features a large empty plot area at the top. Below it is a table with the following data:

	CV1	CV2	CV3	CV4	CV5
TagName	TaiJi_CV1	TaiJi_CV2	TaiJi_CV3	TaiJi_CV4	TaiJi_CV5
ON/OFF	1	1	1	1	1
CurrentPV	1539.972	1539.972	539.9725	539.9725	539.972
AlarmStatus	OFF	OFF	OFF	OFF	OFF
TimeToAlarm (Min)	999	999	999	999	999
HighLimit	1800	1900	800	900	820
LowLimit	1200	1400	200	200	200
DataSource	1	1	1	1	1

On the right side, there is a 'Control Panel' with buttons for 'Load CV' and 'Verify Read'.

## Some Windows of the Test Program (Cont.)

### MV monitoring



### CV monitoring

