A short Note on Pitops

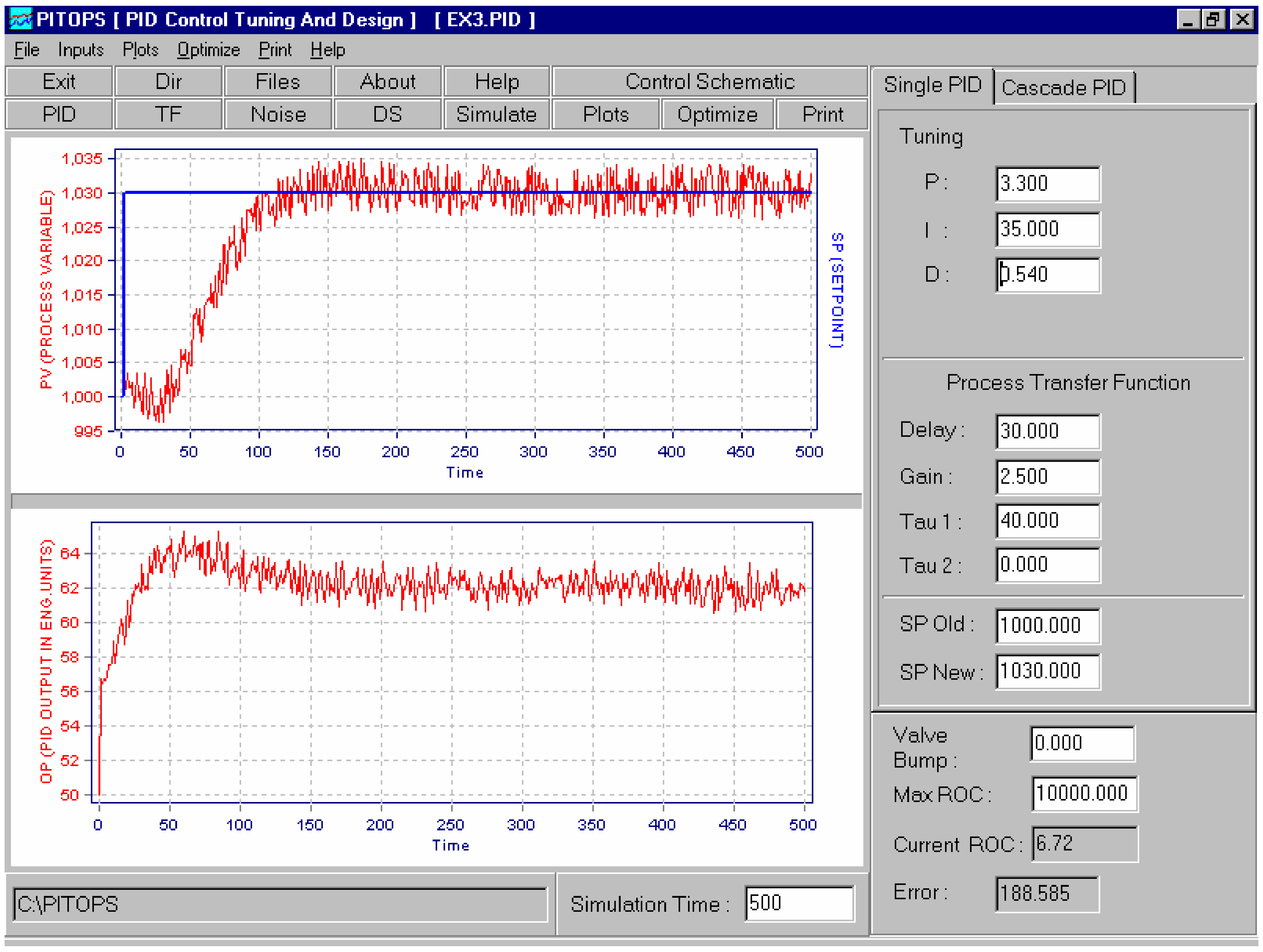
ARTCON

Dear Process Control Professional:

Artcon, Inc. is proud to present Pitops^{TM}, an industrial process control software product. Pitops is abbreviation for **P**rocess **I**dentification and Controller **T**uning **O**ptimizer **S**imulator. It is aimed at developing and commissioning supervisory and advanced control strategies in the DCS or PLC. Pitops was created by a group of experienced process control engineers with years of control room experience on PID tuning, cascade or override PIDs, DCS-based advanced control strategies and MPC systems. Pitops bridges the gap between control room needs and what is currently available.

Pitops teaches the best overall approach for achieving the most out of your DCS or PLC system. Many valuable DCS and PLC features are underutilized in many plants. Often engineers try to use autotuning on PIDs. While autotuning does work in many cases, it may not work optimally for some slow or complex loops and is not advisable for critical or money-making loops.

Figure 1. PID Simulation in Pitops fully matches DCS action



Often new engineers enter the control room. Process engineers often aspire to become controls engineers. Pitops is both hands-on implementation tool and an excellent self-learning controls tutorial package. It is accompanied with two detailed easy to follow manuals that can quickly convert a newcomer to a good controls engineer. Operators, technicians, process engineers can be trained in a day on important process control fundamentals, PID tuning and popular advanced control strategies. Pitops is considered to be the easiest package available today for both training and DCS implementation. The manuals contain several real plant examples with actual plant data and provide step-by-step instructions on how to configure Pitops and calculate tuning parameters fully compatible with the DCS or PLC system.

Pitops software simulates and tunes PID loops. It can be used to tune fast loops like FCs, slow loops like TCs and ramp loops like LCs. Pitops is also beneficial for tuning very slow loops like ACs, where a PID is used for controlling product purities, typically from gas chromatographs in refineries or any other form of online analyzers. Another category of slow loops is override constraint control PIDs. Such loops are used commonly in supervisory control strategies for pushing against a process or equipment constraint. This can lead to increase in plant production capacity from 2-8%. Without Pitops, control engineers typically use the trial-error type of approach, which is slow and not effective. This leads to longer commissioning time and loss of potential plant benefits. Figure 1 shows a simple Pitops PID simulation. Pitops simulations very closely resemble actual DCS trends. This helps to generate operator confidence.

Pitops helps to identify slow or fast transfer functions using plant data consisting of some dynamic tests. Once transfer functions have been identified, Pitops helps to design and tune feedforward control strategies, cascade PID control strategies and other popular supervisory and advanced control strategies.

A typical Pitops sequence is summarized below:

1. Conduct step or pulse tests in plant for a few hours or days depending on loop characteristics. Testing need not be conducted in night shift.

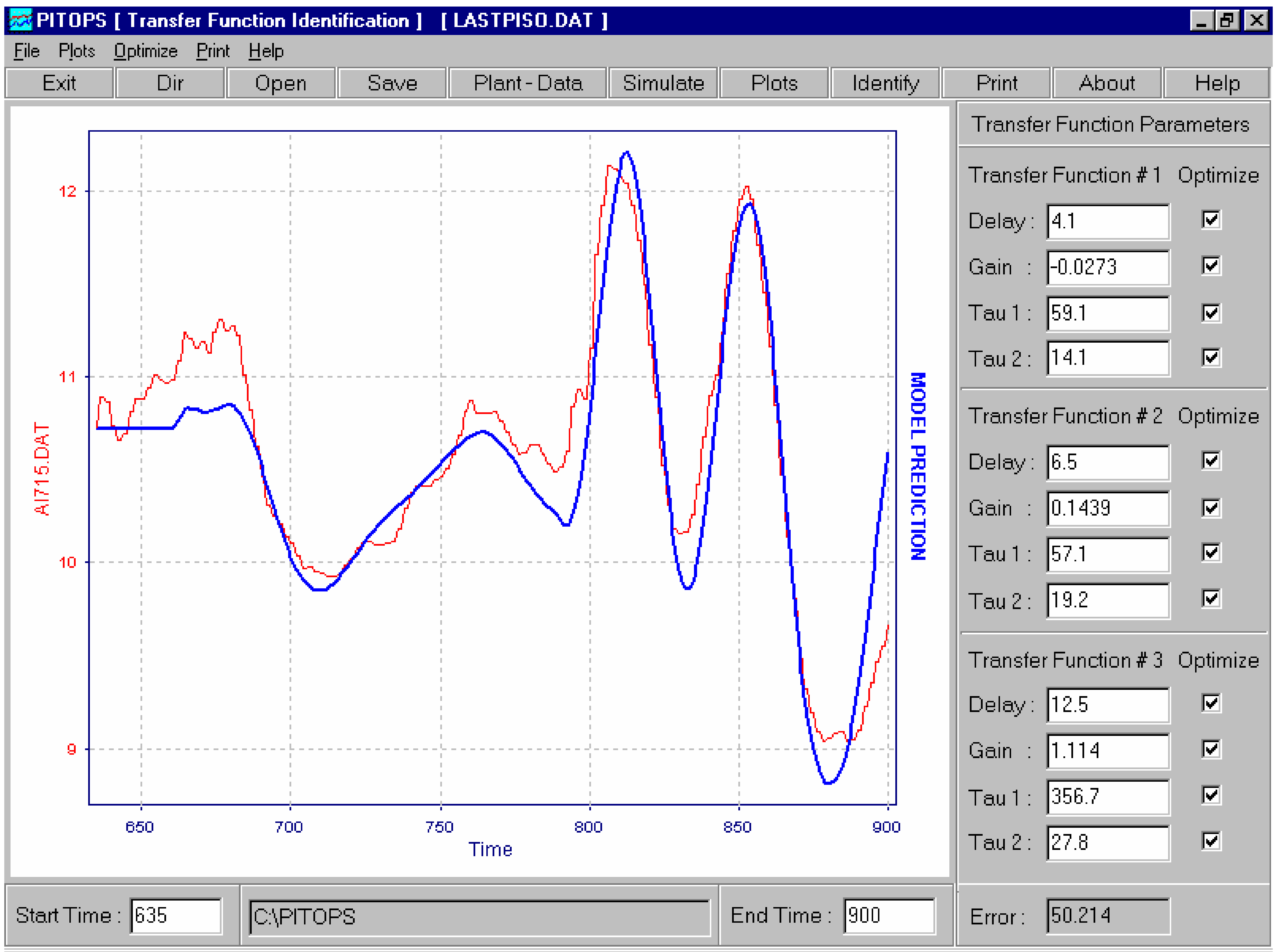
2. Examine DCS trends and visually try to identify process transfer function if possible. Then use Pitops simulator to conduct a "what-if" study with setpoint changes and disturbances on a given PID loop.

3. If transfer function cannot be identified easily by visual inspections of DCS trends as mentioned in step 2 above, then generate ASCII data files containing plant data at some reasonable sample time like 30 seconds or 1 minute. Pitops will read the data files and identify transfer functions. More than one input can be changing simultaneously during the time window. This is one of Pitops' unique features. Most other competitor products can handle only one changing input. See Figure 2 for an illustration showing a multivariable identification using closed-loop data. Once transfer function has been identified, then Pitops simulator can be used to determine the optimal PID tuning parameters.

4. Random noise and real disturbances can be simulated and used to generate true plant like dynamic behavior. Pitops screen trends look very similar to actual DCS trends. This helps in examining and analyzing the closed-loop control action. This is helpful in examining the rate of change in the setpoint of the slave PID loop or valve movement. Excessively fast changes will be undesirable in the plant. By looking at the simulation, one can de-tune the cascade or the slave loop to be consistent with safety and stability requirements.

After inputting PID and advanced control tuning parameters in the DCS, experience has shown very little need for tuning adjustments. Thus, the main emphasis is placed on conducting tests in the plant followed by offline data and tuning analysis with Pitops. Following these recommended procedures results in crisp and stable control. This allows operating closer to product specification limits and pushing plant capacity or other constraints in the direction of increased profit. For example, before tuning, one may be running a distillation column impurity at 100 ppm. After advanced control and good tuning, one could run close to 175 ppm (assuming 200 ppm is the max. limit). This reduces reflux and reboiler duties, thereby not only saving utilities but also releasing extra column capacity resulting out of reduced internal column traffic. There are numerous similar situations where constraints can be released followed by monetary savings. Process stability and increased automation are non-tangible but important benefits.

Figure 2. Three-Input Simultaneous Multivariable Identification using Closed-Loop Data



Our experience has shown that DCS autotuning is acceptable for simple fast loops like FCs. Such loops have almost no process dead time and fast dynamics and tuning is relatively simple. However, for slow loops like TCs, ACs and also most LCs and some PCs, careful custom tuning using Pitops is very beneficial, reliable and safe. Good long term benefits will be achieved using the Pitops recommended approach. DCS autotuning could be dangerous if process conditions change significantly. Also, since slow loops like TCs and ACs can have time constants of 15 minutes to several hours, these long time frames pose challenging problems for most DCS auto-tuning algorithms.

Pitops runs under Windows NT or 95/98 IBM compatible PCS with at least 16 M RAM. For several processes, use of Pitops using transfer functions identified visually from direct DCS trends and the PID simulator analysis may be adequate. Pitops supports PID algorithms in several DCSs. New PID algorithms can be added on request at no extra cost. Tuning parameters from Pitops are fully compatible with the DCS parameters.

Pitops can also be used to improve step response models used in model predictive control (MPC) systems such as DMC, Star and others. A distinguishing feature of Pitops is its ability to work with closed-loop data. For example, an MPC system may have been in service for several months after which some model re-identification may be necessary. Pitops can be used to analyze closed-loop data with setpoints changes made by MPC. It can then determine new gains and dynamics for generating improved MPC models. A repeat of the complete initial test is thus not necessary.

Use Pitops for all your DCS or PLC control tuning needs, you will not need any other tuning tool.