1. Introduction

Generally most of the PID loops in the plant are interacting in nature. It is very difficult to tune the highly interactive PID loops as an individual loop. Most of the interacting loops are slowly tuned to dampen the effect of one on the other, this usually causes cycling or poor closed loop performance. AptiTune has a unique functionality of tuning Multi-Input Multi-Output (MIMO) loops as one set. It identifies the optimum tuning parameters for MIMO loops while taking care of close loop performance and constraints of all the PID loops.

In this case study, a 2X2 (2 inputs, 2 outputs) interacting system is presented. To identify the proper tuning parameters it is required to firstly identify the open loop models. It is generally required to put loops in manual and do some step tests before identifying the open loop model. However in this example, an open loop model is identified using closed loop data. This exercise is highly useful to retune and increase the performance of struggling closed loop PID controllers without spending any time on open loop testing.

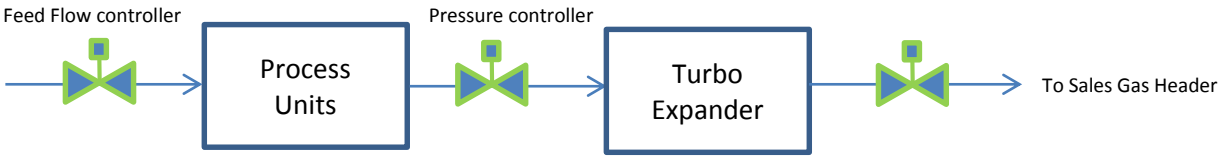
The identified model is further used in AptiTune to get one shot tuning parameters for the interacting system.

Feed Flow Controller v/s Downstream Pressure Controller

This example is taken from one of the NGL Recovery Gas plants in UAE. The feed to the unit is controlled by the feed flow controller and the downstream pressure is controlled by the pressure controller which governs the inlet pressure of the Turbo expander.

The operator usually makes big steps on the feed to control the upstream disturbances which result in increased downstream pressure at the suction of the expander. Since the expander inlet pressure was slowly tuned, the original controller was not able to reject disturbances quickly. Moreover, due to the sluggish behaviour of the pressure controller, the feed to the plant cycled badly which resulted in plant instability and high slippage of valuable NGL in the sales gas.

Schematic overview control loops:



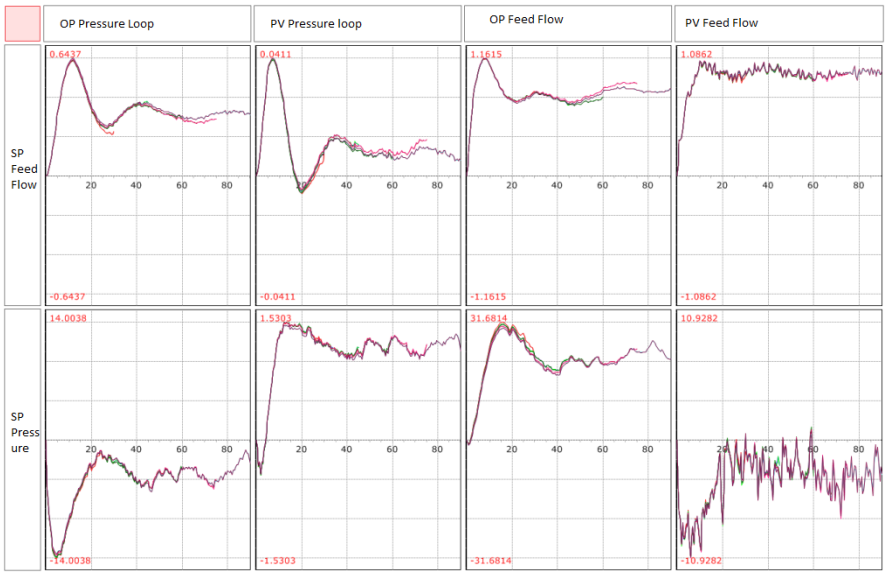
2. Tuning Project Approach

During pre-test activities on the unit it was found that both PID controllers were in auto mode but were cycling very badly. It was decided to retune these loops for better performance of the unit.

A set of closed loop data was used to identify the open loop model using the projection method.

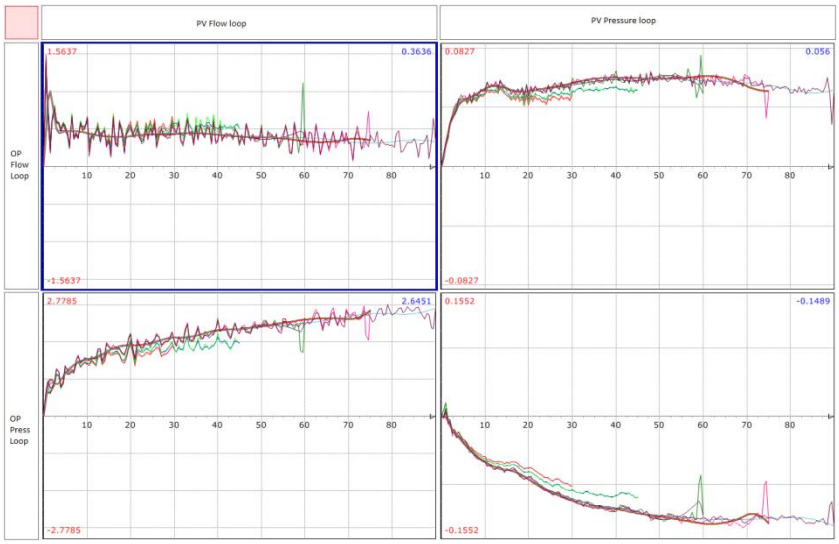
Project steps

1. **Closed loop identification**: The closed loop data was collected for both PID loops in AptiTune. The next step was to perform model identification in AptiTune. The close loop models are identified as:

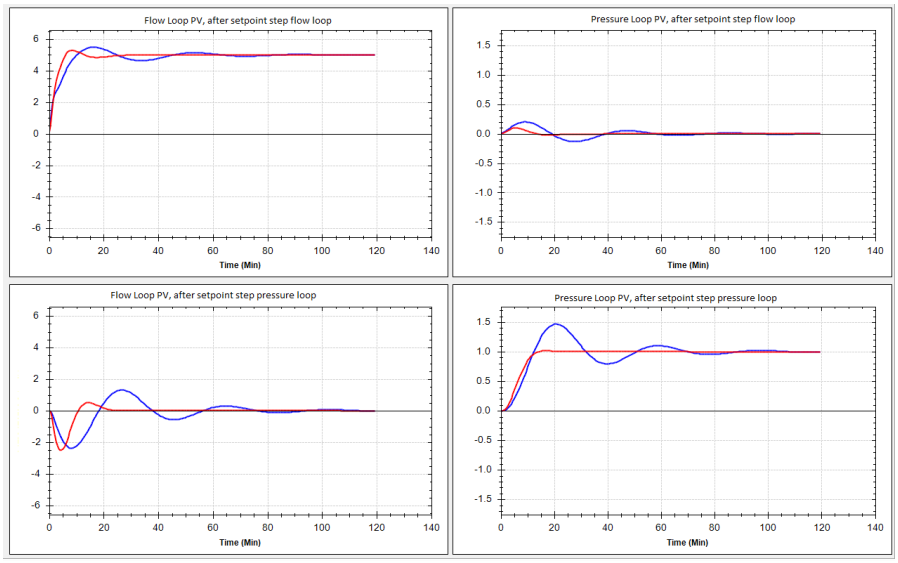


   As can be seen in the screenshot above, the closed loop response has cycles, poor disturbance rejection and a big overshoot in the pressure loop for a set point change.

2. **Open loop model identification:** The prediction generated from closed loop case i.e. predicted OP's and PV's are used to identify the open loop model. These predictions are free from the effect of disturbances and have less effect of feedback regulatory PID controller action. A model identification case was set up in AptiTune with Predicted OP's as independents and Predicted PV's as dependents. The open loop model identified by AptiTune is shown in the following picture:

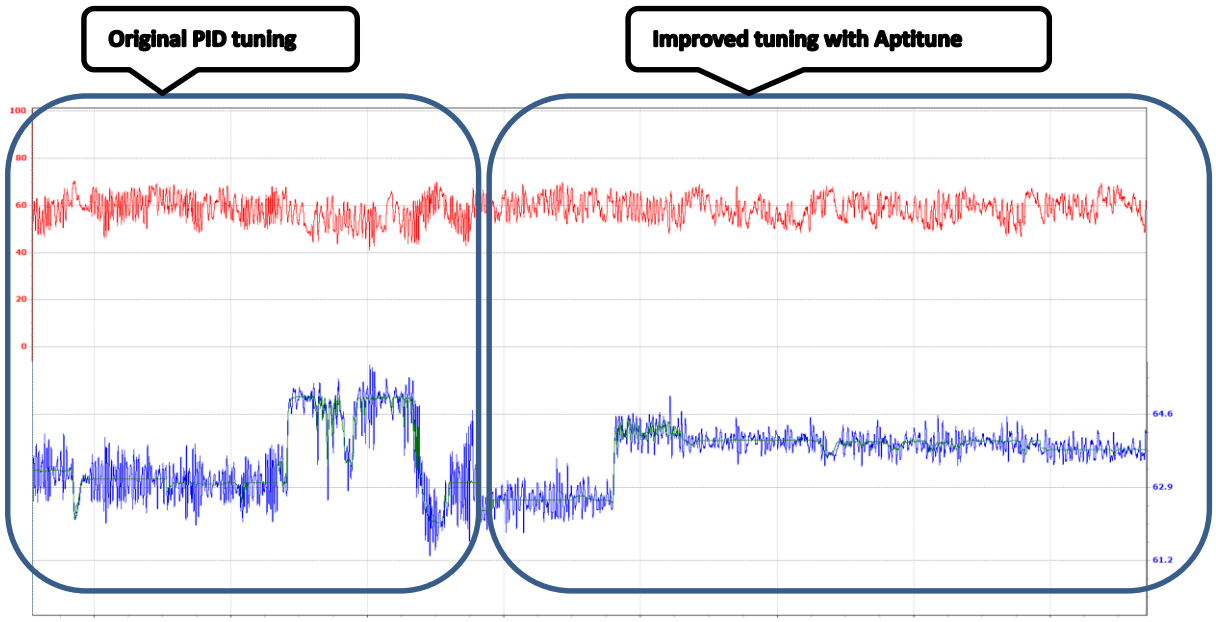


3. **PID Tuning Case:** The open loop model identified is used to identify the optimum PID parameters. In order to increase the disturbance rejection behaviour of the pressure controller, the controller equation is changed from Proportional on Error to Proportional on PV. This equation is set in the ABB DCS. With the proportional term acting on PV only we can increase the PID gain without increasing the proportional kick on set point change and making it faster for disturbance rejections. One shot tuning was identified using AptiTune MIMO case. The better closed loop performance is clearly evident by plotting the existing and new tunings on top of each other.



3. Results

The results of the improved tuning can also obtained from the trend of the pressure loop:



Note: Red signal; OP signal; Blue signal: PV signal; Green signal: Setpoint signal.

4. Conclusion

The two problematic PID loops have been tuned correctly with the use of AptiTune. This allowed a reduction slippage of NGL in sale gas and better plant performance by the rejection of disturbances in a quick and effective way.