



Phase One P3 – Smart Focus

Phase One's Smart Focus is purpose built for the inspection of complex high volume industrial assets such as wind turbines or power towers.

The Smart Focus Features addresses key challenges where contrast based focus fails to deliver robust and consistent results. The superior performance is delivered by:

- Increasing focusing robustness in low contrast environments
- Increasing focusing consistency when complex
 assets with small surface area

All are based on the P3's 100Mp medium format sensor, high quality AF lens range and the integrated laser based focusing system

Phase One P3 Smart Focus Features					
Phase One iXM 100MP and RSM AF Lens Range					
Integrated Laser Range Finder					
Focus Bracketing			Focus Limit Control		
Behind Focus Point	Around Focus Point	In Front of Focus Point	Clip Distance	Gate Distance	Relative Distance



Consistent and Robust Focus Point



What is Contrast

 Contrast is the difference in luminance or colour that makes an object (or its representation in an image or display) distinguishable. In visual perception of the real world, contrast is determined by the difference in the colour and brightness of the object and other objects within the same field of view.

Challenge of Contrast within inspections

• To ensure that the camera focus on the right object and have full control of the focus point in a low contrast environments



Depth Of Field



What is Depth of Field

• The depth of field (DoF) is the distance between the nearest and the furthest objects that are in acceptably sharp focus in an image captured with a camera.

Challenge of DoF witnin inspections

 The challenge for an inspection system is to capture the full Depth of Field (DoF) if this exceeds the DoF of a single image



Advanced Focusing Feature: Focus Bracketing

4: Image sequence with changing focus distance



1: Distance to the object - Measured with the P3's laser range finder

2: Width of the asset - Provided by the asset owner

3: Field of Depth (FoD) - Calculated

4: Number of images required to capture the full depth of view - Calculated

Why use Focus Bracketing

- To get more effective flight time as the operator only position the UAV once per image sequence
- To Increase consistency regardless of the skill level of the pilot. This makes it easier to scale the inspection operations
- To Increase automatization as the need for a human in loop for quality assurance is reduced

When to use Focus Bracketing

• When you need to inspect many deep and complex assets with many details in areas that are remote or inaccessible making reflying very costly



Focus Bracketing Modes



Behind Focus Point

• The focus distance is changed after each trigger moving backwards (away from the UAV) as defined in the Bracketing settings.

Around Focus Point

• This bracketing mode takes out in the focus point being in the middle of the object. The Images will be captured as in 'Behind Focus Point' by moving back relative to the UAV.

In Front of Focus Point

• Here the focus starts from the back of and move forward towards the UAV as defined in the Bracketing Settings



Focus Bracketing - Implementation in DJI Pilot App



- Enables and disables the focus bracketing feature
- Set the number of pictures and bracketing steps in the sequence. Use the calculator to find this based on your mission data

Select the bracketing mode:

- Behind focus point: The laser range finder is used to indicate the closest point of the asset and the focus bracketing stack will then move away from the UAV
- Around focus point: The laser range finder is used to indicate the centre of the assets. The focus will then be moved away from and towards the UAV
- In front of focus point: The laser range finder is used to indicate the furthest point of the asset and the focus bracketing stack will then move forwards the UAV



Advanced Focusing Feature: Focus Limit Control



Why use Advanced Focusing with Min / Max settings

- To reduce the chance of images being out of focus even in complex low contrast environments
- To facilitate enhanced mission automatization with mission planning software
- To make it easier for new pilots to capture high quality data
- To increase output consistency
- To reduce the chance of needing to refly mission – especially in inaccessible or remote locations



Clip Distance: Lens focus distance follows within min/max



How <u>Clip Distance</u> works

• The user set the min and max focus distance. This is the default mode when using advanced min / max focusing

Example(s) of when to use Clip Distance

• When inspecting large assets where the chance of the Laser Range Finder missing the target is low such as building façade.



Gate Distance - Ignore large focus distance changes



How Gate Distance focus works

 The user set the min and max focus distance. If the laser range finder measures a distance outside the min / max range the lens focus settings will remain constant until a range inside the focus min / max range is measured.

Example(s) of when to use Gate Distance

• When capturing medium sized objects like a wind turbine blade and external factors such as wind makes it difficult to keep the laser range finder stable on the desired Focus Point



Clip Distance vs. Gate Distance



Clip Distance vs. Gate Distance

- Clip Distance sets the lens focus range to min or max if a range is measure outside min / max
- Gate Distance leaves the lens focus range if a range is measured outside min / max until a range within focus limits is measured



Relative Distance - Ignore range changes outside a user defined Relative focus Threshold



How Gate Distance works

• Even if the laser range finder measure a range inside the user defined min / max focus distance but still a significant change compared to the focusing outset the lens focus range will not change.

Example(s) of when to use Gate Distance

• When you need to capture thin complex structures such as a power tower



Gate Distance vs. Relative Distance





Relative Distance

Gate

Distance

Gate Distance vs. Gate Distance

- Gate Distance leaves the lens focus range if a range is measured outside min / max
- Relative Distance leaves the lens focus range if a range is suddenly measured inside the min / max range



Focus Limit Control – Implementation in DJI Pilot App

