

PORT DEVELOPMENT
MID-WATER
AUTONOMOUS PLATFORMS CAMERA

OPTICAL DESIGN PROPOSAL
SUBMITTED TO
MBARI

Prepared By:

Paul Remijan

Micro-Optech Consultants
89 Allen Hill Road
Brimfield, MA 01010

413 245 3996

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Objectives of Optical Design

Current high resolution cameras using large format sensors and high resolution lenses do not perform well in water when used with a concentric dome. The port to be designed will consist of a non-concentric front element with a multiple element corrector group. The multiple element port described as a PC, (Panoramic Corrector), will correct aberrations caused by the water-glass interface. Aberration correction provided by PC will cause the limiting system resolution to be defined by image formation parameters of the sensor-lens combination.

Approach

Specific configuration of PC is dictated by image area of sensor and optical parameters of camera lens. An accurate compensation of water-glass aberrations requires compatibility with selected camera lens. A minimum requirement for proceeding with a PC design is an optical layout of camera lens generated from paraxial parameters. **This proposal is valid if and only if paraxial parameters of camera lens are available.**

Two basic approaches to PC design can be used:

1. If a camera lens with focal length greater than 12 mm is used, a small amount of angular magnification can be designed into PC to achieve FOV specification. DOF is increased with this approach.
2. If a camera lens with focal length less than or equal to 12 mm is used, a PC with angular magnification of ~ 1 will achieve required FOV.

Optical Design Procedure – MBARI Collaboration

PC optical design activities will commence after MBARI selects a camera lens and associated design approach. Completion of front lens design will require engineering collaboration to confidently meet depth specification.

1. MBARI will suggest an initial front lens CT as a starting point for PC optical design. 12 mm CT is the current starting value.
2. MBARI will review optical prescription of front lens, add edge configuration details and determine if front element will meet pressure requirements. Up to three optical design iterations of PC with suggested changes of front lens thickness are within the scope of this proposal.

Deliverables

PC optical design operating within MBARI System Design Requirements, (06AUG14 – rev. A), will be provided. DOF requirement is identified as being potentially difficult to attain and may actually drive the design approach to option #1 above, regardless of selected camera lens focal length.

Optical Design Performance Documentation

1. Optical layout with Rim Rays
2. Polychromatic MTF
3. Ensquared Energy
4. Field Curvature-Distortion Plot
5. Spot Diagrams

Optical Fabrication Documentation

1. CAD Drawings of all PC lenses (except front element)
2. Partial Drawing of front element, (MBARI collaboration required)

Optical Fabrication Support

1. Contact Chinese vendors – (Fathom Imaging)
2. Suggest USA vendors

Lens Assembly – Spacer Design

1. Up to 4 hours of support/collaboration for spacer design and optical assembly procedures is included within the scope of this proposal.
2. Additional tasks involving optical assembly and spacer design can be provided in a separate project or billed at rate of \$150 per hour.

Estimated Optical Fabrication Costs:

1. PC optics fabricated in China – Estimate US\$ 2500 – 3000 per set.
Additional front lenses might cost ~ US\$ 700 each.
2. Estimate PC optics fabricated in USA would cost \$15000 – 20000 per set.
Additional front lenses might cost as much as \$4000 each, depending upon edge bevel details and optical coatings.

The above estimates for USA fabrication are just a **wild guess**. Estimate of Chinese fabrication costs are also a rough guesses, but they are based upon extrapolation of current costs for similar optical components purchased by Fathom Imaging.

Cost of PC Optical Design:	\$6600.00
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