

IAF EARTH OBSERVATION SYMPOSIUM (B1)  
Earth Observation Sensors and Technology (3)

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CHALLENGES AND SOLUTIONS OF FREE-FORM OPTICS DESIGN FOR HIGHLY PERFORMANT  
EARTH OBSERVATION INSTRUMENTS IN SPACE**Abstract**

Cost-effective space borne Earth-observation instruments require small form factors while maintaining excellent optical performance. Freeform optical elements offer a solution to this challenge. Employing freeform optics has seen an increase in popularity with the advance of new manufacturing techniques. However, the design of freeform optical systems still poses challenges to optical engineers as off-the-shelf optical analysis and design software packages often reach their limits in optimizing such systems. OHB System AG has thus developed its own optimization algorithm that overcomes the limitations of commercial software packages by employing differential raytracing together with automatic differentiation. Our software is capable of optimizing refractive, diffractive, and reflective systems with an arbitrary number of surfaces and with full flexibility over all degrees of freedom. Superior optical designs can now be designed that use either less volume, are simpler to align, or exhibit an increase in performance compared to their reference systems. This contribution will introduce the concepts of our algorithm, followed by the discussion of exemplary Earth-observation instrument concepts that use freeform elements. A summary describing the benefits of freeform optical systems for Earth observation instruments concludes this contribution.