AEH's Optomechanical Modeling Tools

A suite of applications developed to save time and money in the design of optical systems.

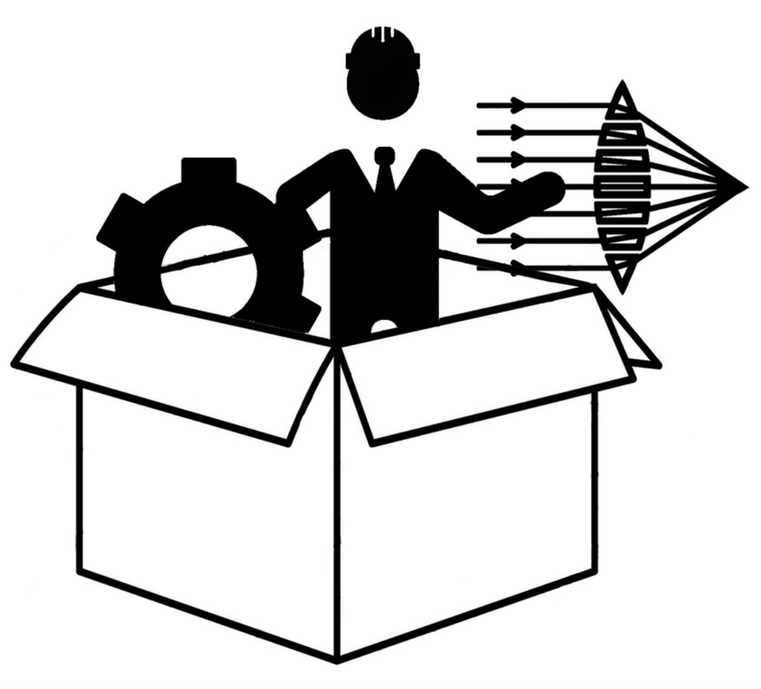
2022

AEH.

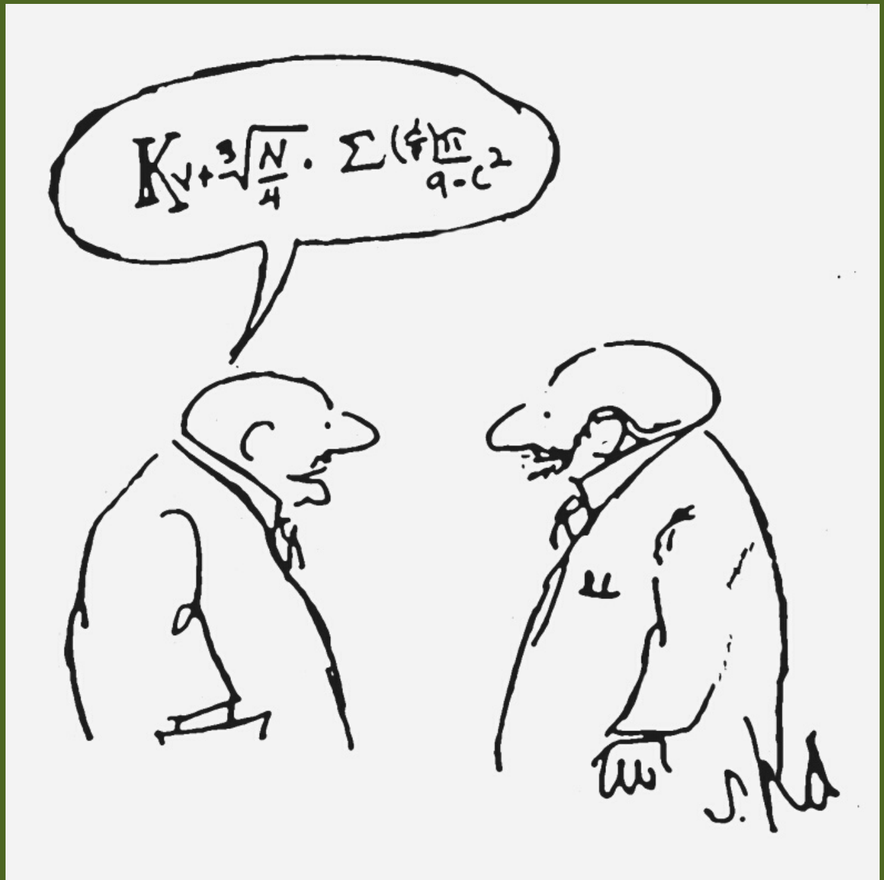
Engineered Solutions

AEH's software is like having a world-class optomechanical engineer in a box...

.... accelerating and optimizing the optical design process.



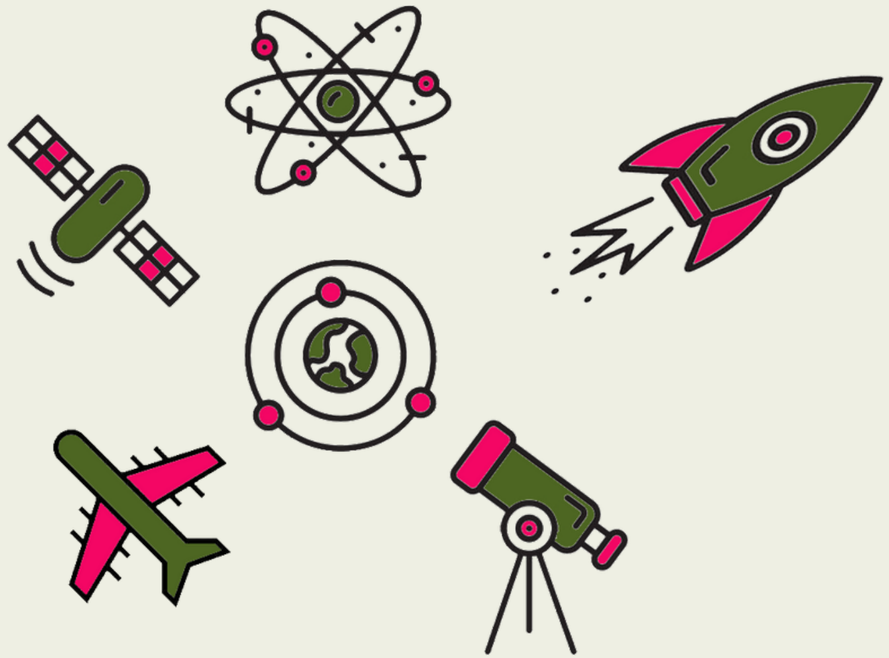
Optical systems are designed by people who work in different disciplines.



AEH's Optomechanical Modeling Tools

- map optical requirements onto mechanical designs
- support optical and mechanical engineers from concept through production
- developed by world-renowned optomechanical engineer, Alson Hatheway

Increase fidelity of optical end products.

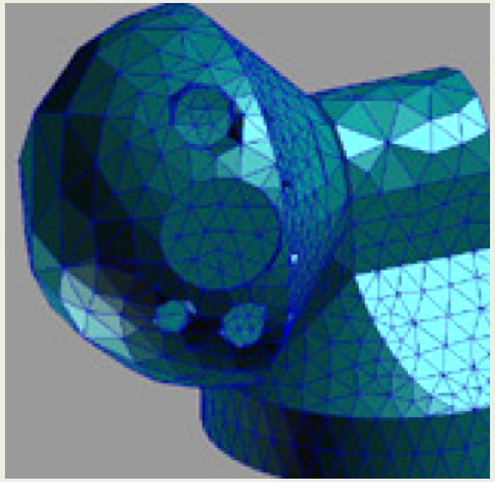


Do you want to drive optics into the future? Push systems beyond conservative calculations? Maximize budgets? Optimize decision making? Accelerate the design process?

Save money and time by getting your optical and mechanical designs on the same page <u>from the start.</u>

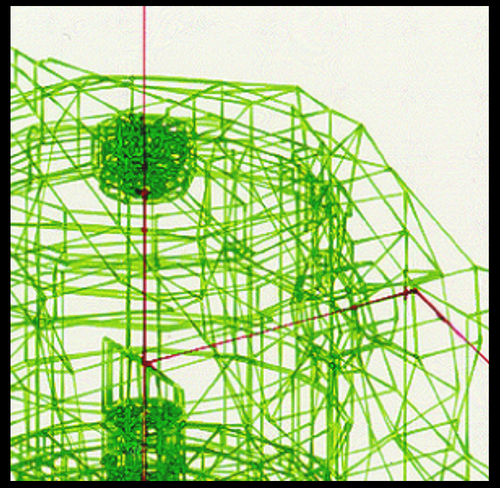
Tools by AEH eliminate uncertainty and error.

Ivory



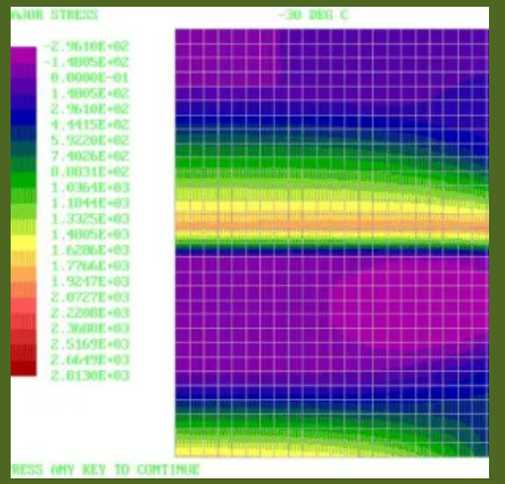
Ivory processes a system's optical requirements to produce the structural geometries for finite element analysis.

Ebony



Ebony reveals mechanical deformations on the surfaces of optical components *within* the mechanical engineer's finite element code.

Jade



Jade determines the fatigue life of a stressed glass part in varied service conditions to optimize safest concept.

Ivory, Ebony & Jade productize the expertise of the finest optomechanical engineers, driving down costs and reducing time to market.

What one of the nation's top optomechanical engineers has to say:

"Alson's greatest contribution to optomechanics was his ability to link computer aided design in mechanical engineering to computer assisted design in optical engineering: *something the rest of us have been unable to do*. His software is the bridge between those two disciplines."

- Daniel Vukobratovich

Senior Principle Multi-Disciplinary Engineer at Raytheon Missile Systems
Adjunct Professor at the Wyant College of Optical Sciences, University of Arizona
2020 SPIE President’s Award Recipient

Our competitive landscape:

Benefits	AEH Suite of Applications	SigFit	Optomechanical Consultants	OpticsBuilder
bridges optical and mechanical sign conventions	●	●	●	◐
savings of time and money by reducing iterations	●	◐	◐	◐
built for mechanical *and* optical engineers	●	●	◐	○
designed specifically for use with NASTRAN	●	◐	◐	○
lightweight and fast <1 second	●	○	○	○
earliest implementation for proof of concept / prediction	●	○	○	○

AEH tools serve multiple markets.

Industries:

• Aerospace • Astronomy • Biomedical/Life Sciences
• Industrial Applications/Commercial • Military and Commercial
• Aviation • Academics and Research • Security/Defense

Professions:

- Optical Engineers
- Mechanical Engineers working with optical systems
- Optomechanical Engineers (also our competition)

  Many Optomechanical firms have developed proprietary algorithms which they guard in order to charge for their services. Since AEH is widely respected as the gold standard of optomechanics, it is reasonable to expect that these firms would incorporate our tools into their offerings.

Optical Engineering Industry is Large and Growing

ADAPTIVE OPTICS MARKET

$109B by 2024 [1]

83.9% CAGR

OPTICAL COMPONENTS MARKET

$282B in 2018 [2]

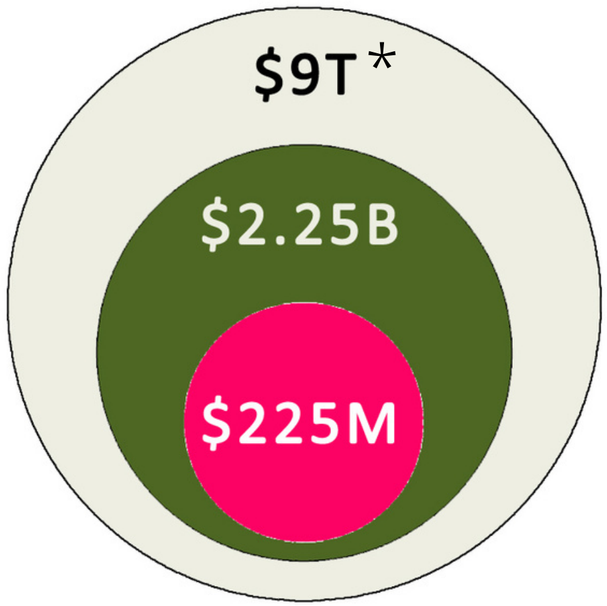
10.6% CAGR

...and all optical systems require structures.

1. Transparency Market Research: https://www.transparencymarketresearch.com/adaptive-optics-technology-market.html
2. SPIE Report: Optics & Photonics Industry Report Fall 2020

Market Opportunity

AEH's software tools provide time-saving answers for optical engineers and mechanical engineers working with optical systems.



Total Licenses of Top Software Publishers (TAM) – 1.8M users

top 3 optical design software publishers
top 3 mechanical design software publishers

Serviceable Available Market (SAM) – 448K users

25% of licenses being used to design optical systems

Serviceable Obtainable Market (SOM) – 44.7K users

10% of users in SAM which are likely to adopt our software

*Numbers represent best guess based on independent market research and assuming an average of $5000 per license.

About AEH

Founded in 1979 by Alson E. Hatheway, AEH Inc. has a reputation as the United State's preeminent optomechanical analysis and design company. Simply put, Alson Hatheway was the best optomechanical engineer the US had to offer.

Alson's unusual mastery of both optics and mechanics made him a highly sought after designer, advisor and consultant on hundreds of contracts over the course of his career. He wrote the codes for Ivory, Ebony & Jade to make his job faster and more efficient.

Al's commitment to the industry led him to develop and nurture a thriving community of optomechanical engineers. Although he practiced as a mechanical engineer, he is highly decorated within the ranks of the optical community (SPIE, OSSC, AIAA).

Named for valuable materials used for carving fine works of art, Alson saw Ivory, Ebony & Jade as valuable tools for producing the highest grade optical images.

Alson E. Hatheway

President, Principal Engineer

AEH Inc.

AEH Today

Teale Hatheway

Artist, Founder Pearl & Maude

Represents the intellectual property of Alson E. Hatheway

My Promise

My name is Teale Hatheway. I am Alson's daughter and I represent the intellectual property of Alson E. Hatheway.

Alson was brilliant and meticulous. He had incredible integrity and was highly respected by his colleagues. It is my honor to represent him.

I had the opportunity to work with Alson and I know how he operated within his business. His mind produced innovations which continue to provide value to the industry he nurtured. Now, I have forged the path to re-homing Alson's life work. I look forward to placing his software applications in the hands of a company who will take them to new heights.

An Opportunity to Grow

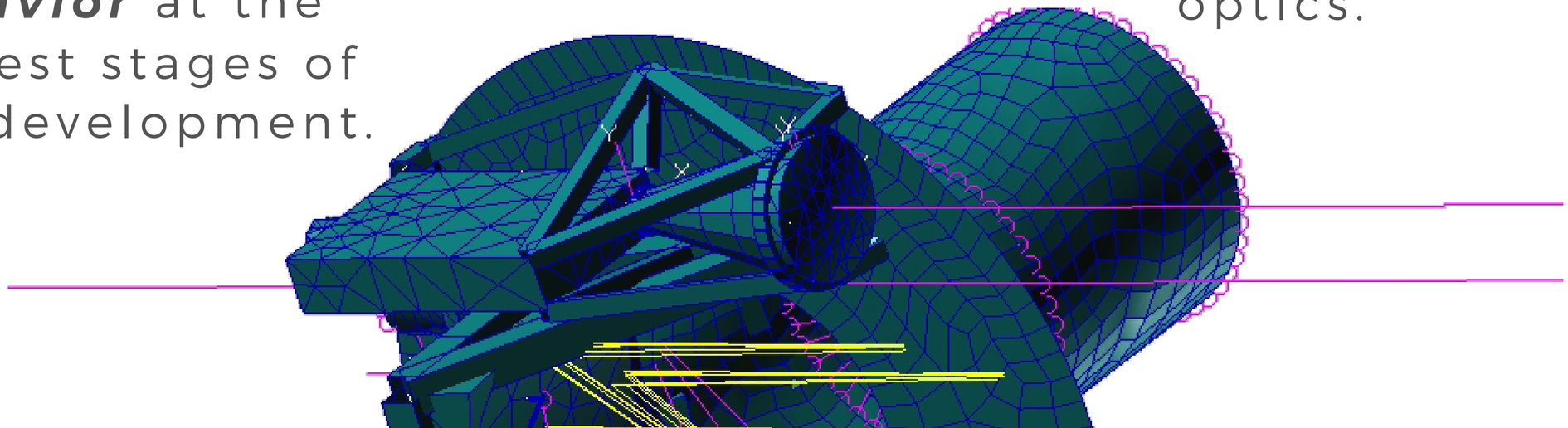
We are seeking a company looking to grow revenues and market reach through acquisition or license of world-class optomechanical design tools.

Conclusion

AEH's Suite of Optomechanical Tools saves time and money. It transforms optical modeling by ***predicting optical behavior*** at the earliest stages of pre-development.

Ivory, Ebony and Jade are written to work as stand-alone tools or ***in conjunction with Nastran.***

Backed by the most respected industry experts, Alson's work is ***important and valuable*** to the growing field of optics.



Contact

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for writings, papers, presentations and more, please visit:

aehinc.com

Advisors

The process of re-homing the intellectual property of Alson E. Hatheway has been supported by industry leaders, including:

- Dan Vukobratovich - Senior Principle Multi-Disciplinary Engineer at Raytheon Missile Systems; Adjunct Professor at the Wyant College of Optical Sciences, University of Arizona
- Martin Seilonen - Program Manager | IPTL | Engineering Manager | Optical Systems | Opto-Mechanics, Northrop Grumman Space Systems
- Mark Kahan - Chief Electro-Optical Systems Engineer, Synopsys, Inc.
- Dae Wook Kim - Assistant Professor of Optical Sciences and Astronomy, University of Arizona
- Keith Doyle - Assistant Division Head, Engineering, MIT Lincoln Lab
- Krisztina (Z) Holly - scouting, advising, and investing in innovators at the frontier
- Joshua Tarbutton, Ph.D., P.E. - Associate Professor/Assistant Director, Energy Production & Infrastructure Center Mechanical Engineering and Engineering Science, UNC Charlotte
- Harvey M. Spencer - Director of Optical Engineering at Leonardo DRS

"IVORY focuses mainly on determining the effects of alignment errors on first order imaging properties while other optical design software focus mainly on properties associated with wavefront errors such as the RMS spot size."

- Esperza, M., Choi, H., & Kim, D.W. (2021). Cassegrain Telescope Sensitivity Analysis using Ivory Optomechanical Software. *College of Optical Sciences, University of Arizona*

"In addition to providing the mechanical engineer with a better understanding of the impact on optical performance, IVORY can generate input for use with mechanical FEA tools. At present ZEMAX/CODE V etc cannot do this. There are ways to generate a simplistic model but it is not easy to tie this to the optical design. IVORY provides this link."

- Douglas Osborne
Independent Ivory User

"IVORY... can perform an independent sanity check of ZEMAX optical sensitivities... Furthermore IVORY is capable of writing the OSE in NASTRAN syntax code including all necessary coordinate systems that define both the optic rigid body displacement six degrees of freedom and the image motion relative to the focal plane directions. Implementing the OSE in a Finite Element Model is a difficult task because the optical sensitivities have different sign convention definitions in the following data sets: IVORY Optical Sensitivities, ZEMAX Optical Sensitivities and NASTRAN Finite Element Model OSE syntax code."

- Assessment of Optical Software Ivory.
Goodrich-Danbury Mechanical Engineering