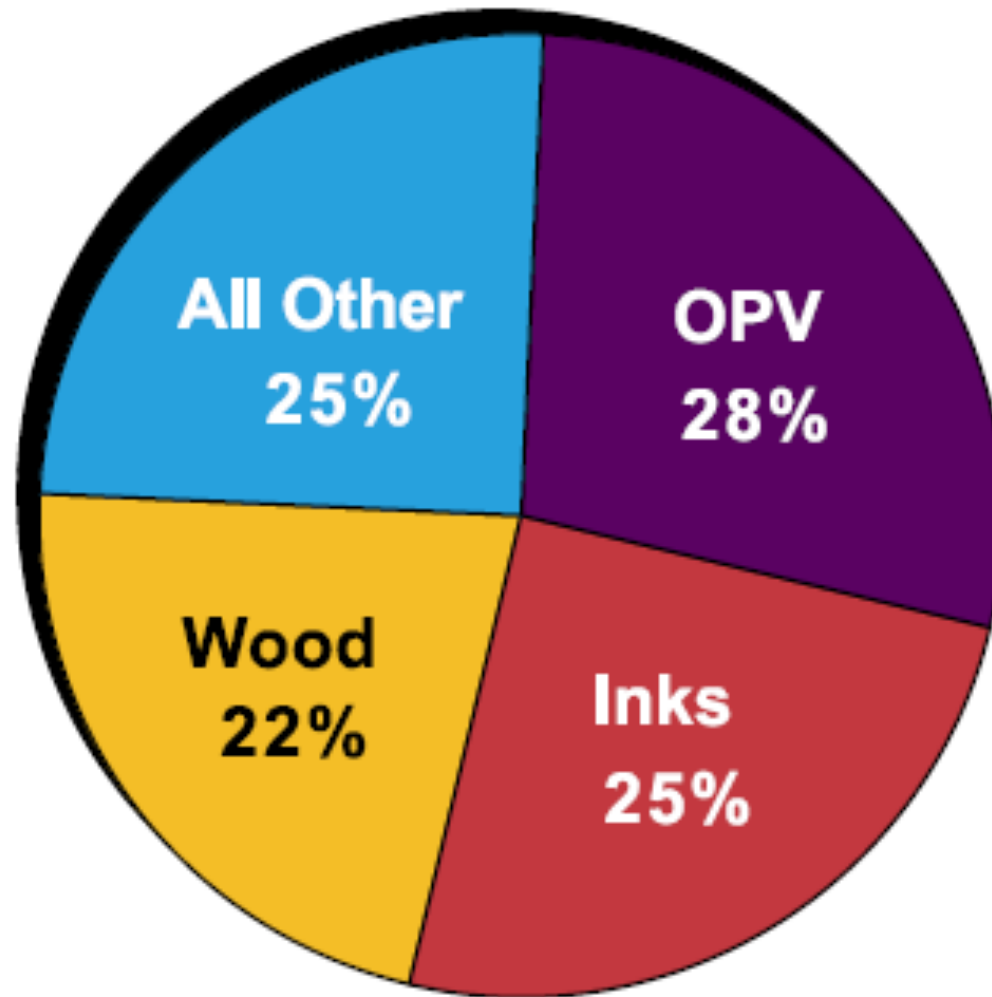


Robotic UV Curing for 3D Parts



Paul Mills
UV Robotics



Status of UV Curing in North America.
2010, RadTech N.A.

Big Share*

Fiber optics
CDs/DVDs
Over Print Varnish on paper
Screen printing
Coated labels
Premium no wax flooring
Ophthalmic plastic lenses (certain types)
RTA furniture
Automotive headlamps
Photoresists used in circuit boards and chip manufacture
Pre-finished hardwood flooring
MDF fillers
Particleboard fillers
Window film coatings
Photopolymer printing plates
Decorative films (certain types)
Mummification (3-5000 years ago, Egypt)

* End uses where UWEB already holds a double digit share, ranging from 30% to close to 100%.







From *Spectrum*
Fusion UV

Team UV, a curing perspective:

Kevin Jozsal, Business Development Manager

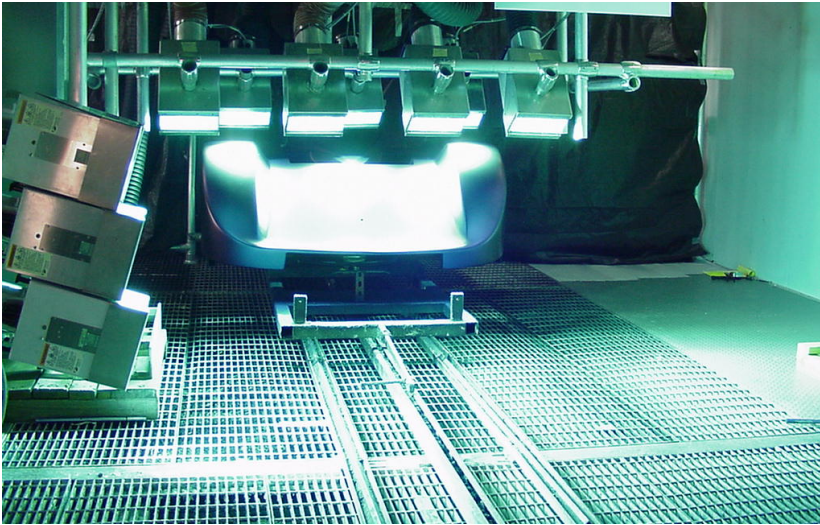
Almost two year ago, Paul Mills of Nutro Corporation, formulated the idea of using a SCCA Ford Spec Racer as the platform to demonstrate the feasibility of UV curing technology for automotive coatings. He easily convinced Fusion UV Systems, BASF, and Giba Specialty Chemicals the value of his concept, and Team UV was born. The Team UV racecar is a very effective demonstration of the possibilities UV technology offers for automotive coatings, specifically, the ability to cure large three-dimensional parts.



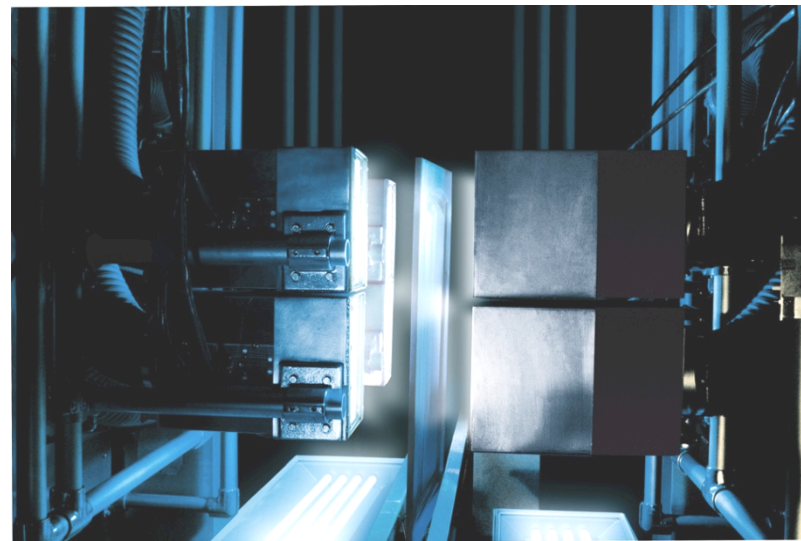
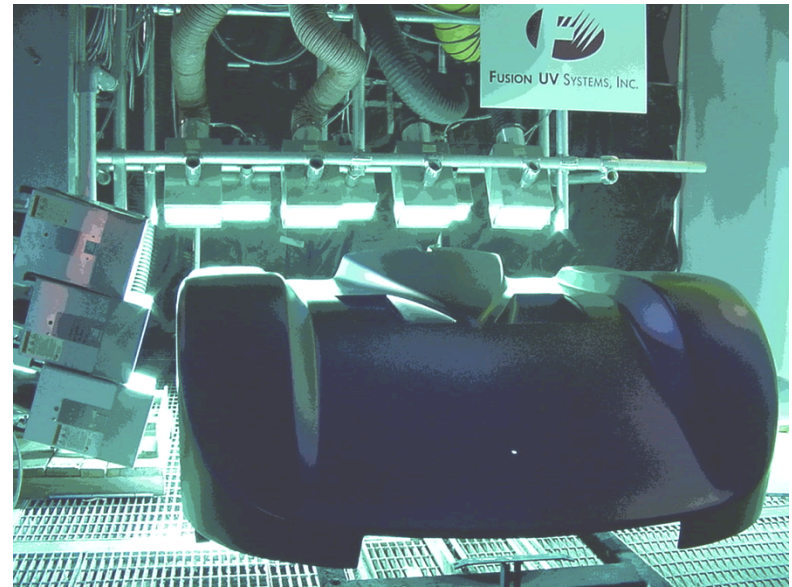
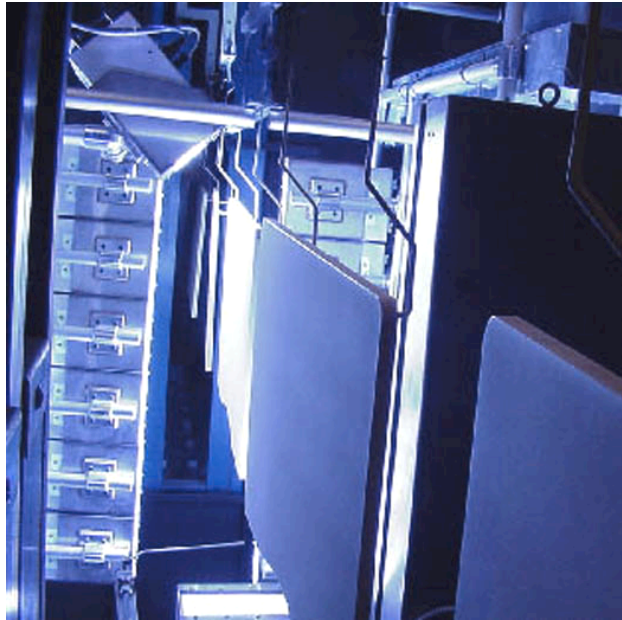
The first question (where) wasn't too difficult to answer. Ransburg has Fusion UV Systems' equipment installed in the 3-Process Development Laboratory located in Toledo, OH. How

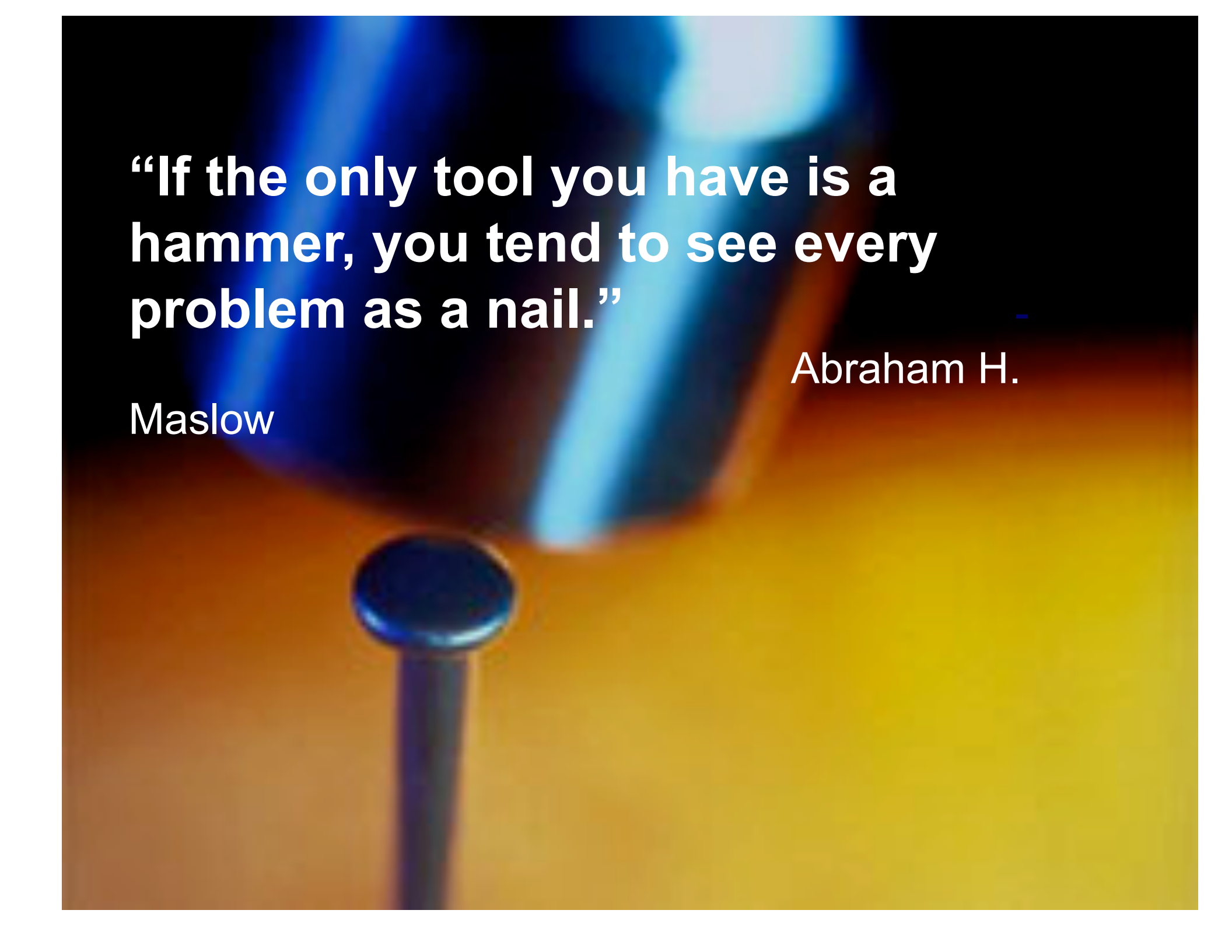
once the dimensions of the parts were reviewed,

Manufacture of the Team UV Racecar



- Produced in three pieces with 10 fixed lamps.
- Each part run twice (180° rotation)
- Radiometry revealed a “best fit” but not completely uniform





“If the only tool you have is a hammer, you tend to see every problem as a nail.”

Abraham H.

Maslow



Coating Development

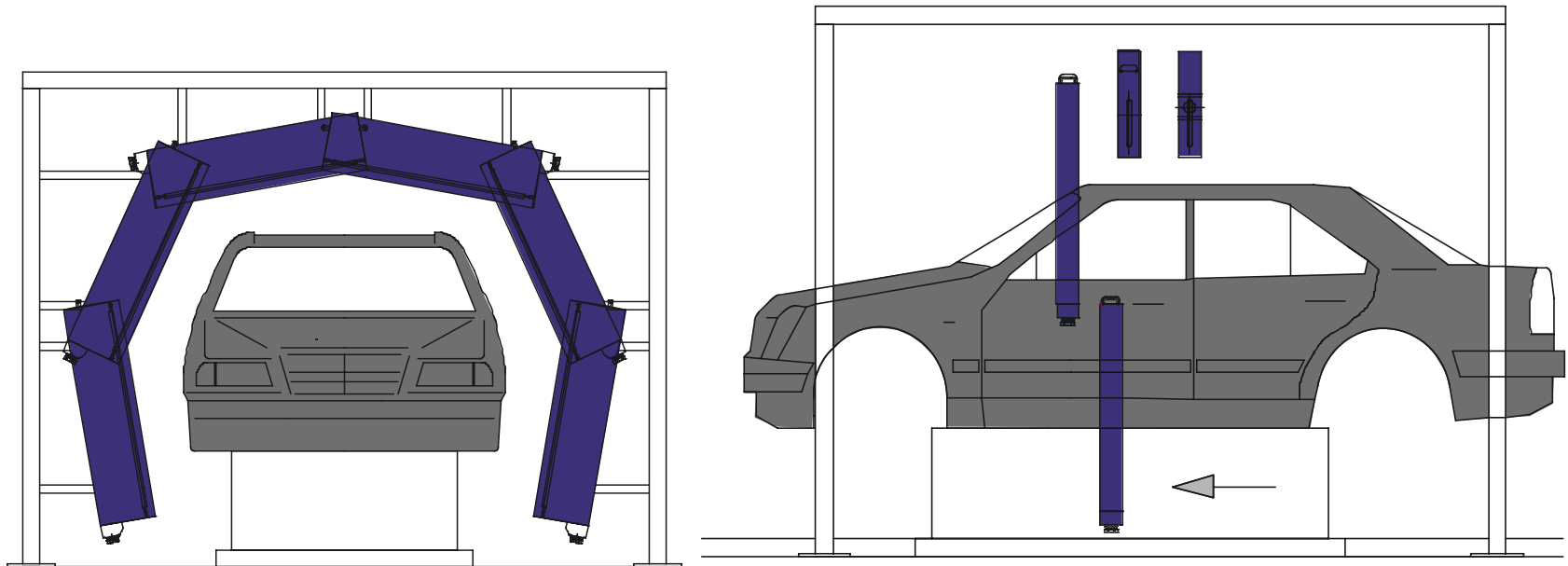
Process Development

Complete Cure

Robust Process

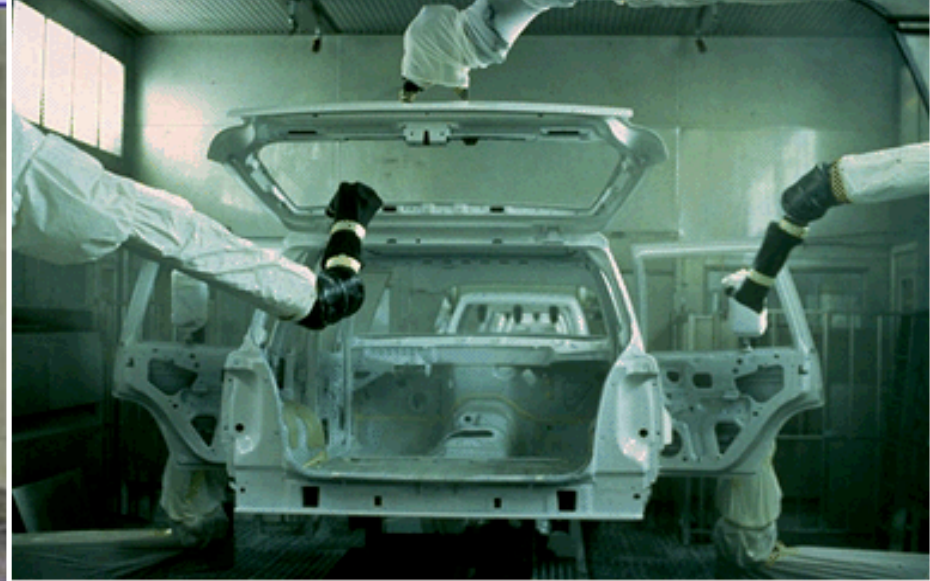
Reasonable Cost

Light tunnel approach using various size UV lamps to optimize cost and exposure



Concerns with a Fixed Lamp Approach

- High Capital Cost
 - Lamps, cooling, fixtures, integration
- High Operating Cost
 - Replacement parts
 - Energy
 - Downtime
- Technical Adequacy
 - Complete cure
 - Proper Re-alignment
 - Mixed product



This is the same problem faced in the paint application process. Robots and reciprocating applicators assure uniform paint film is applied to all coated surfaces.

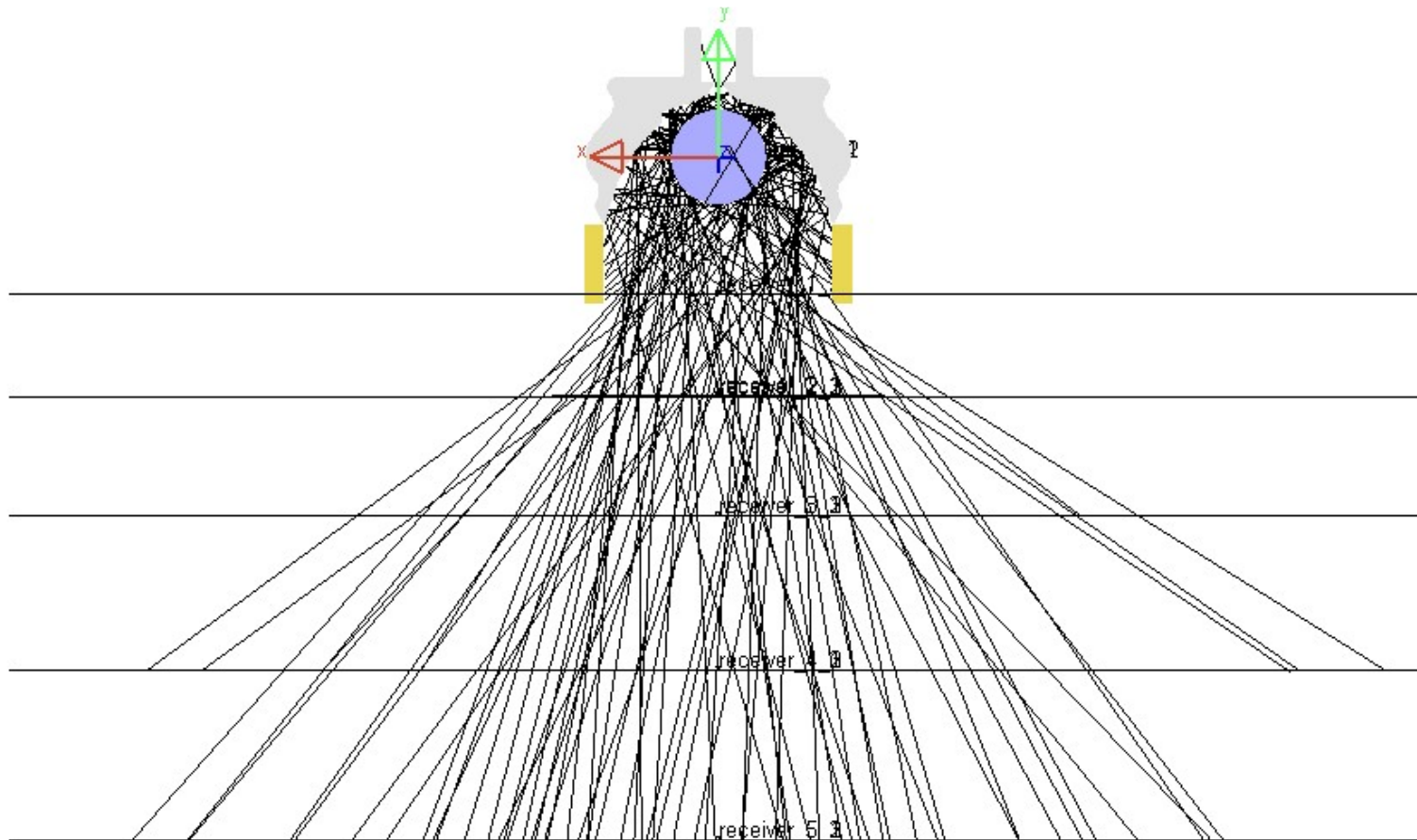


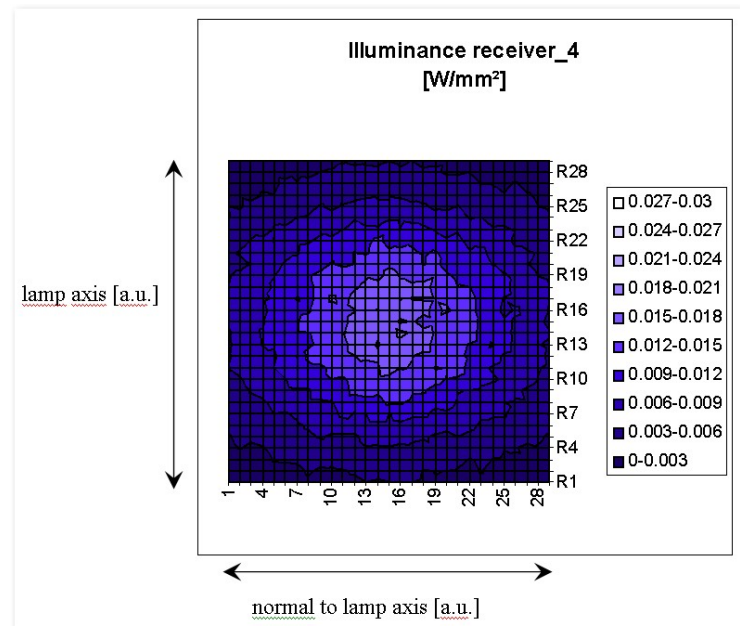
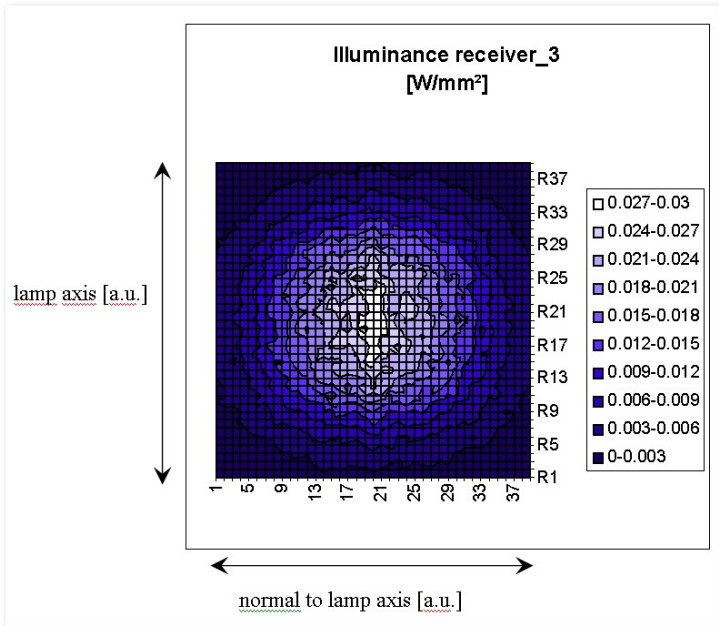
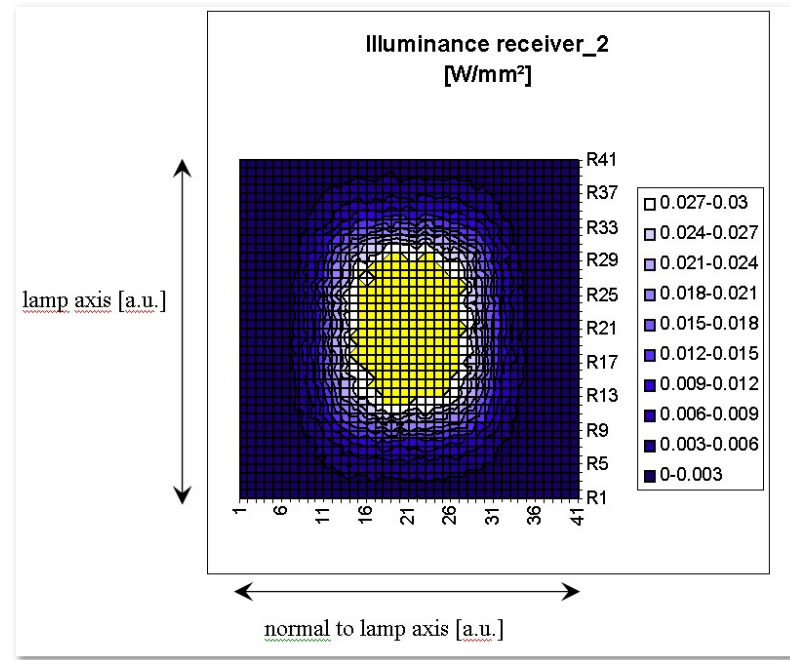
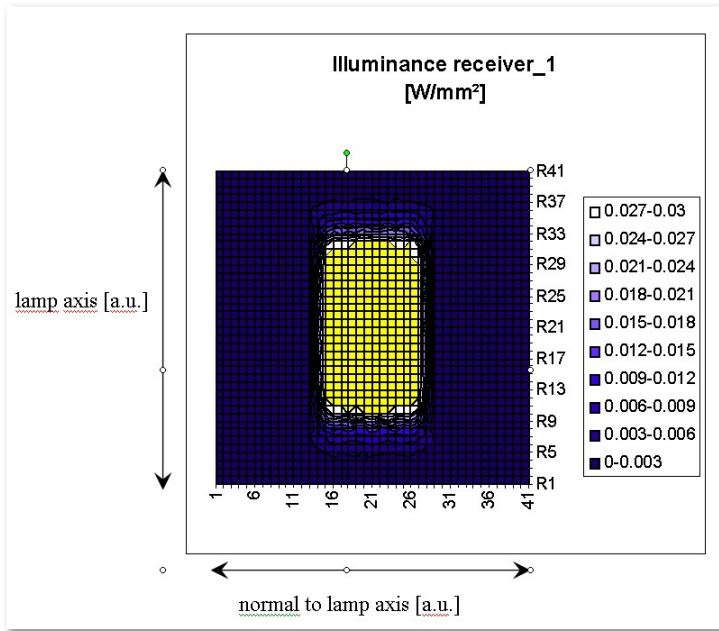
**Daimler-Chrysler
Ulm, Germany**

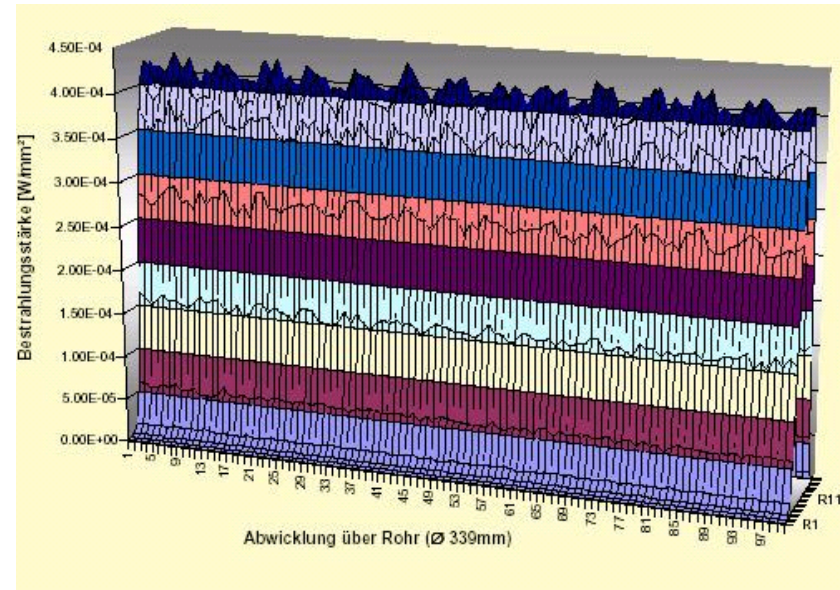
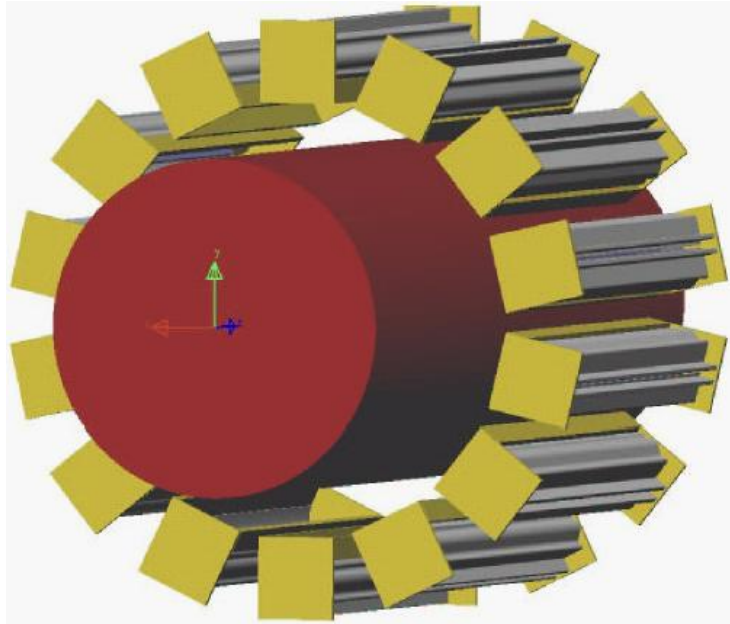


**Cleveland, Ohio
Test Lab**

Ray Tracing model of an IST MBS Minicure lamp designed for Robotic curing applications.

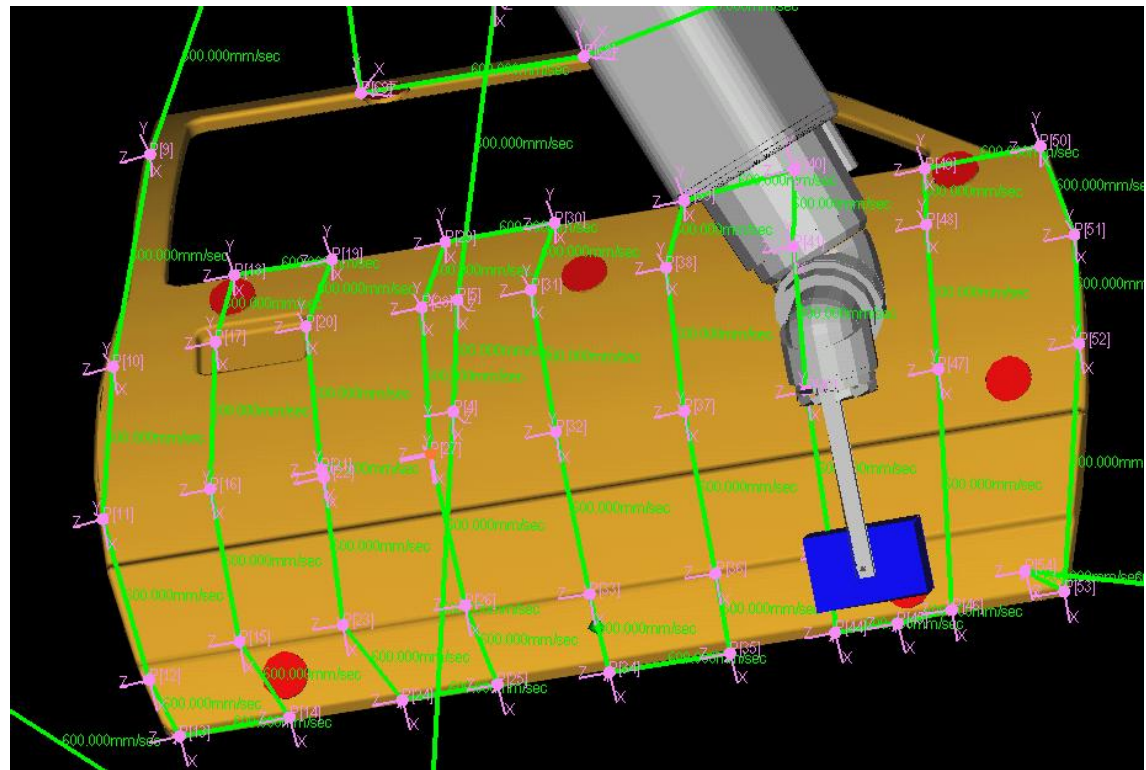


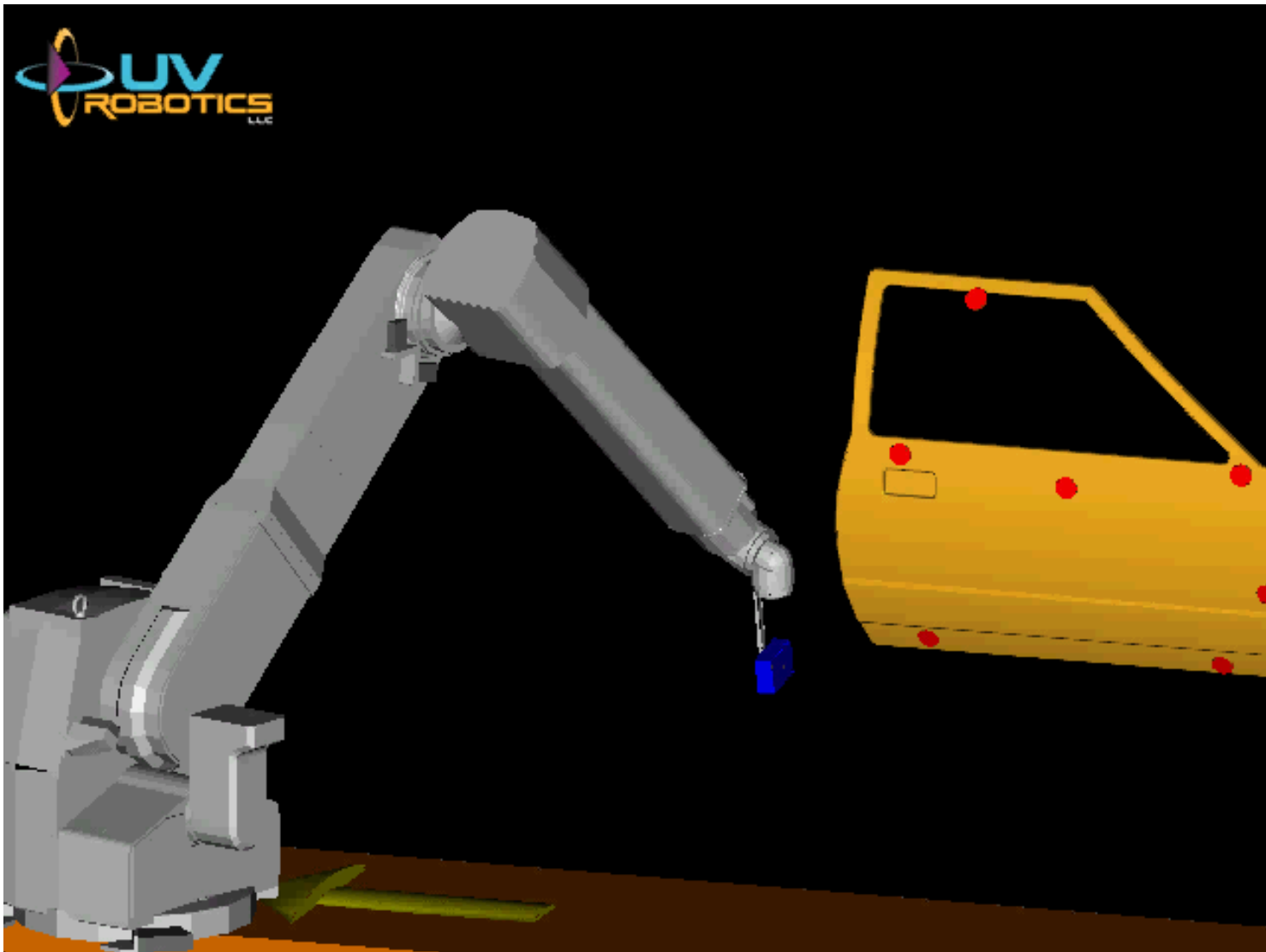


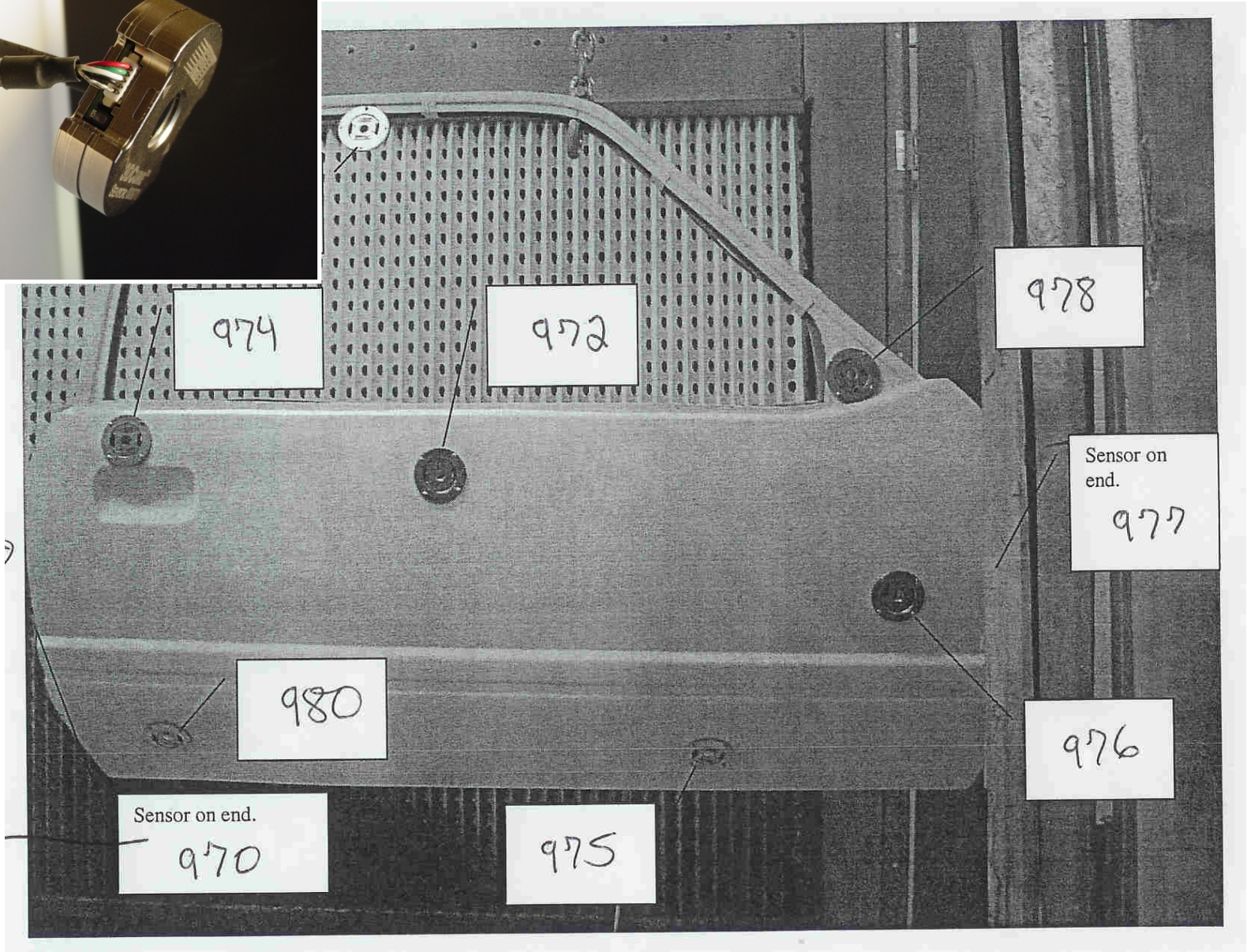
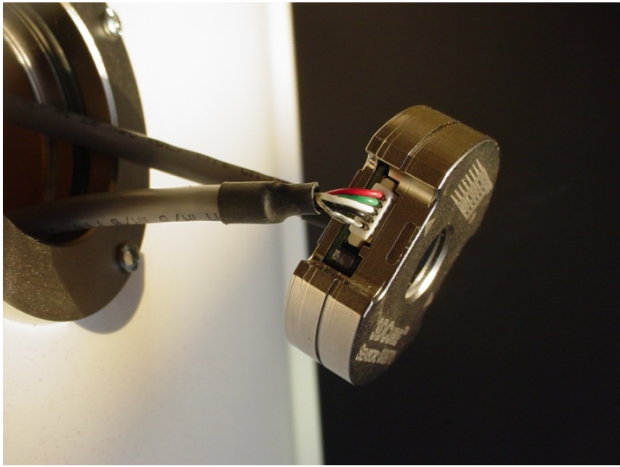


Analytical study of a large number of small lamps used to irradiate a symmetrical geometry of constant radius. The results show non-linearity exists.

New tools to facilitate offline simulation of robotic UV curing. The tools allow for rapid path development and solve problems associated with overlap, striping, etc.







974

972

978

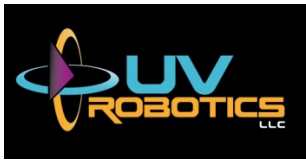
Sensor on end.
977

980

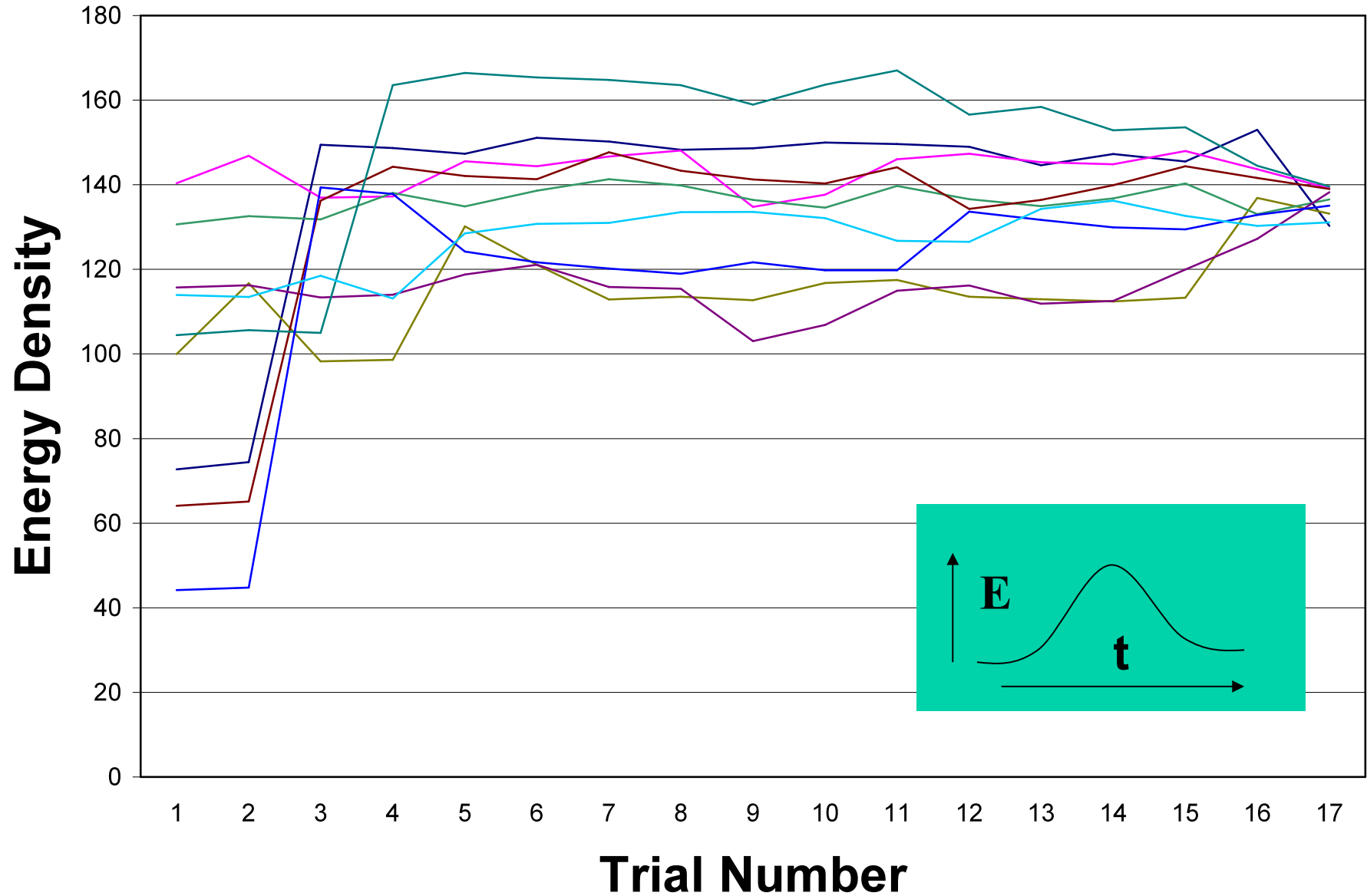
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Sensor on end.
970

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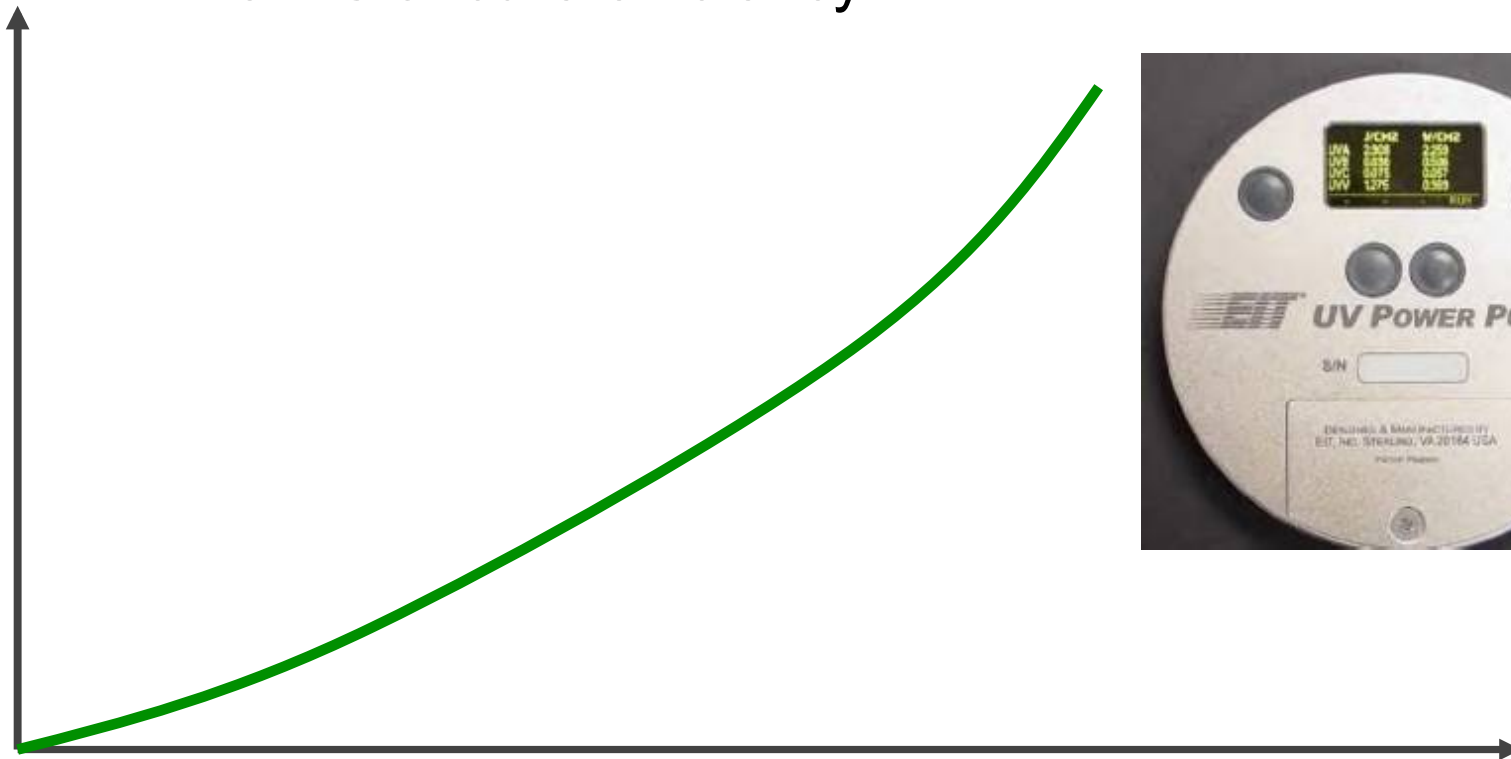


Path Tuning for Uniform UV Dose



The robots ability to achieve very close (and uniform) target distances offers the opportunity to achieve high peak irradiance.

This often provides a disproportionate benefit in terms of cure efficiency.





Automotive Lighting Comparison



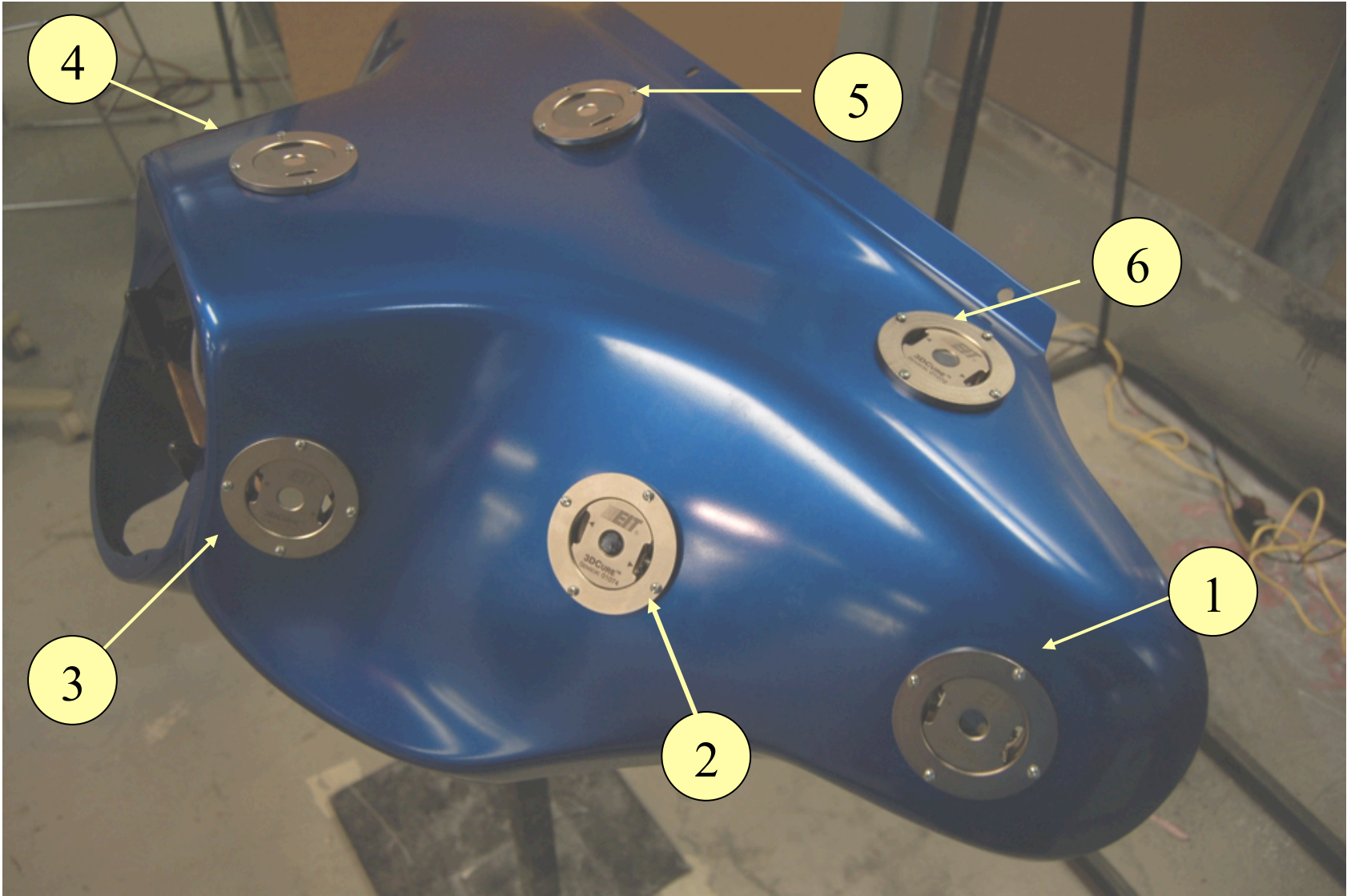
Fixed Lamp Approach

- 12 x 600 W/in lamps
- 6-8 Joules UV

Robotic Approach

- 1 robot cell
- 2.5 Joules UV
- 12 second cycle
- 300 parts/hr

Cycle Time Requirements: 200 parts/hour



4

5

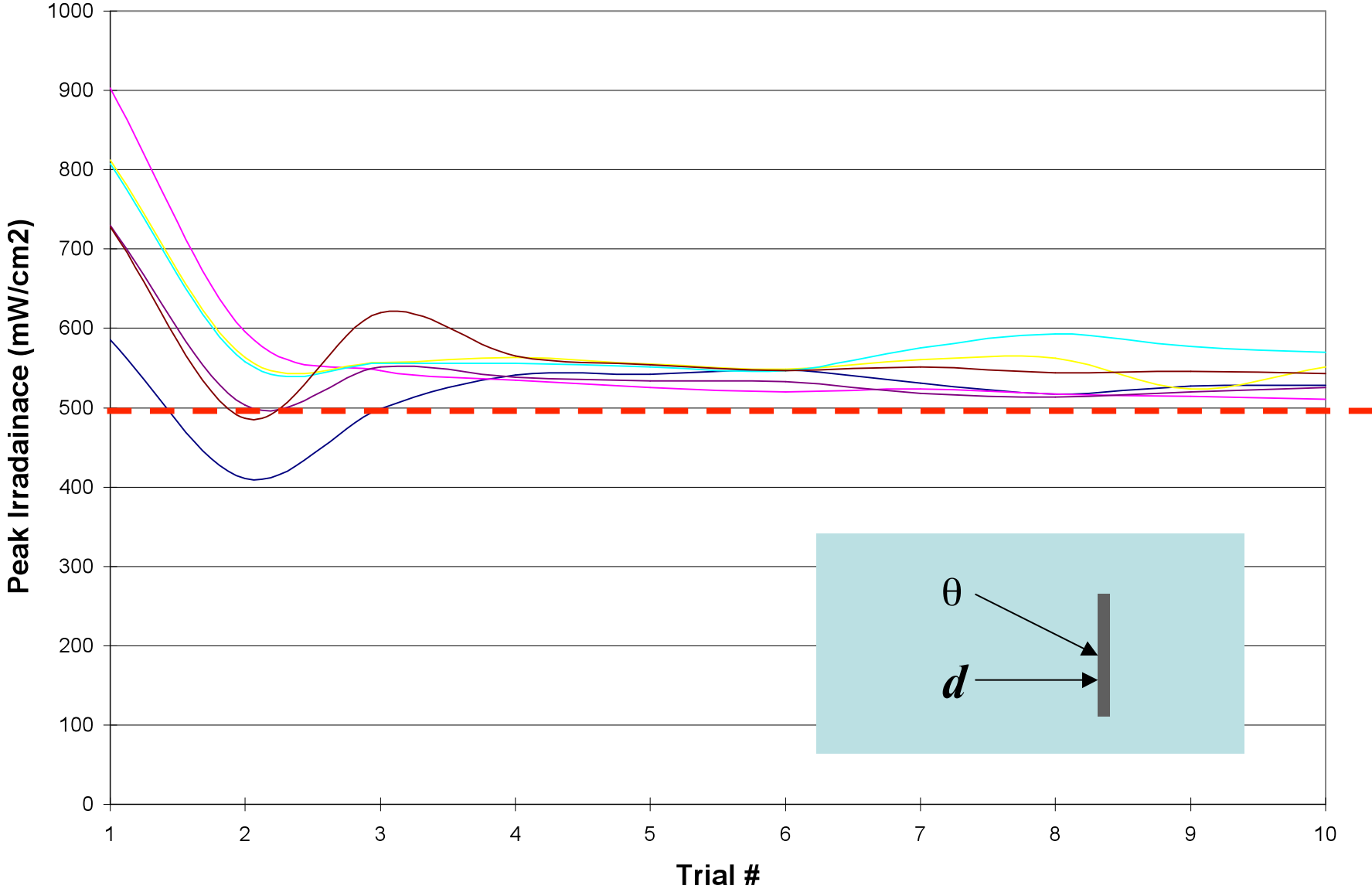
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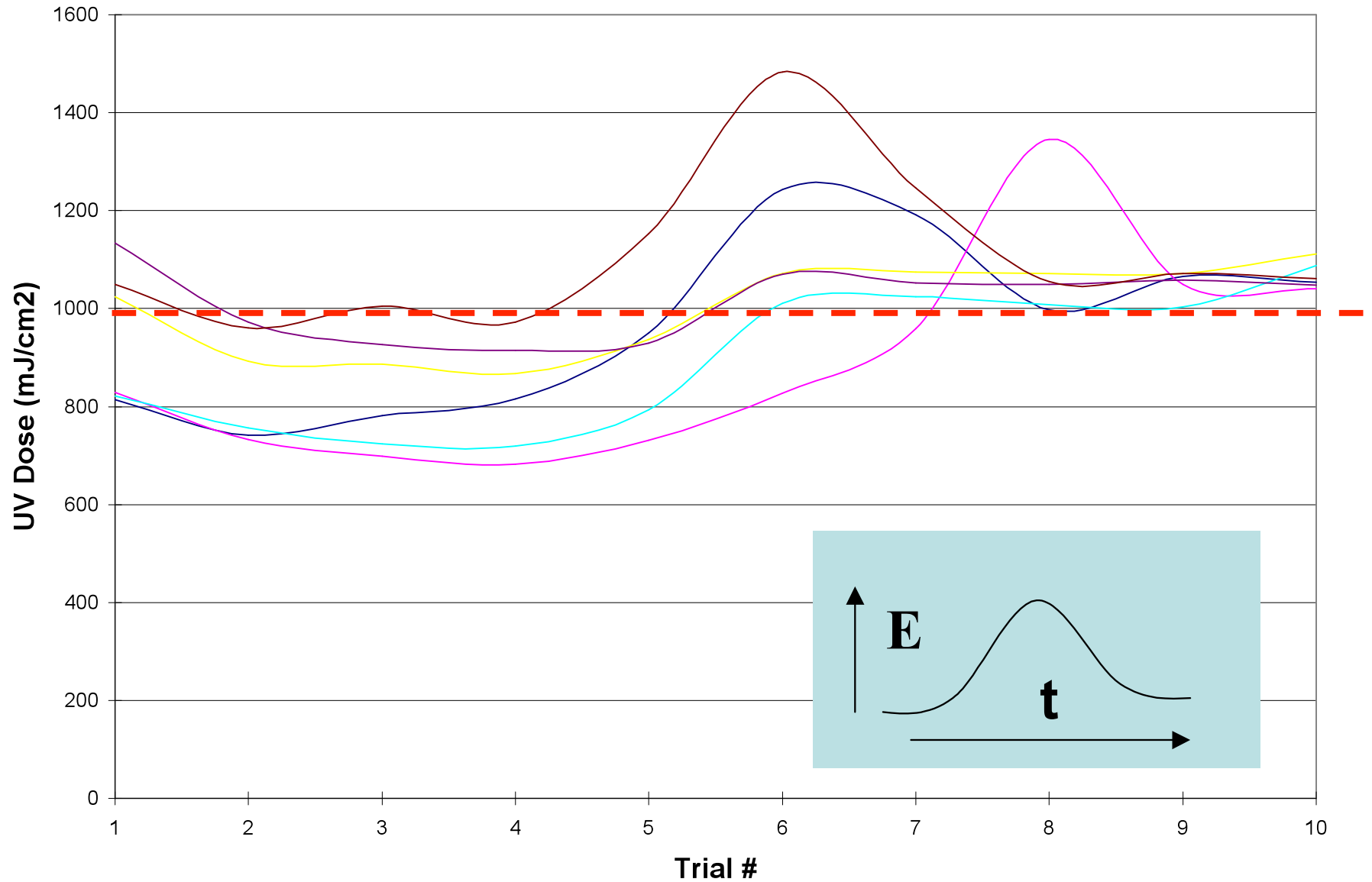
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1

Peak Irradiance Trials - Fairing



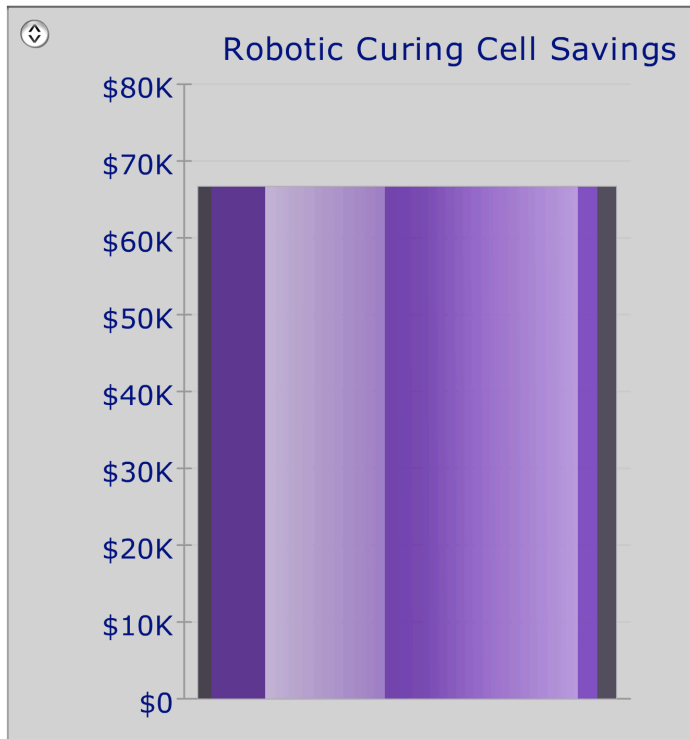
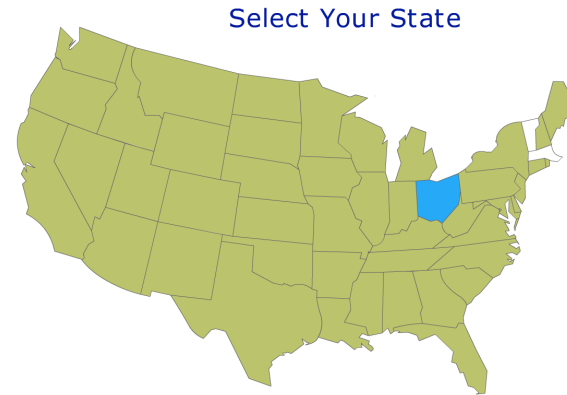
UV Dose Trials - Fairings





Total UV Robotics Savings

NaN



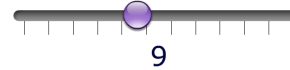
Fixed Lamp Type

- 300 W/in Microwave
- 450 W/in Microwave
- 600 W/in Microwave Fixed
- 600 W/in Microwave Variable

Bulb Type

- Mercury
- Iron
- Gallium

Number of Fixed Lamps



Hours / Day



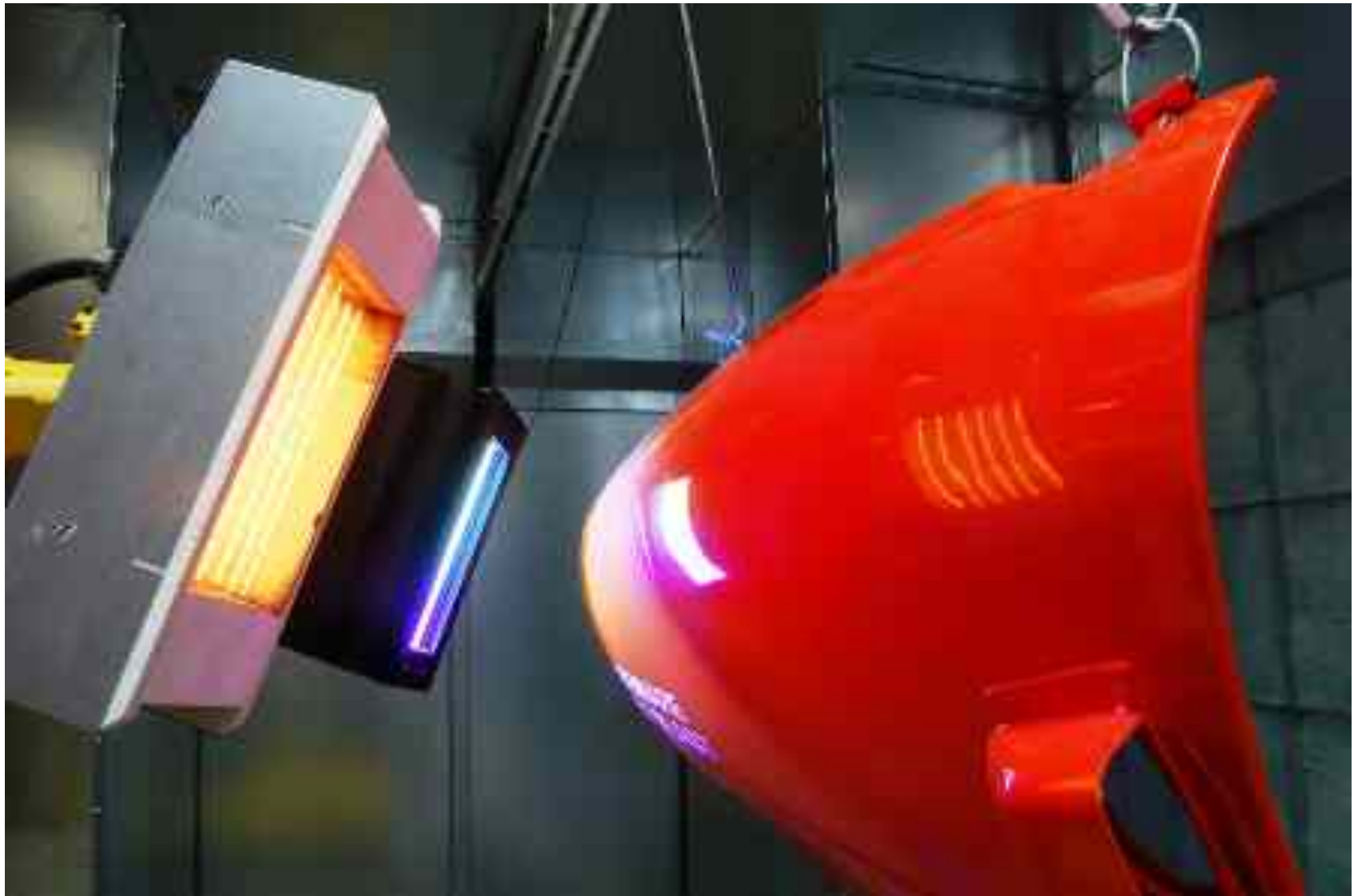
Days / Year



Save Model

Scenario

Visit us at www.uvrobotics.com



Summary

- Robots & UV are not new – making them work is.
- Some lamps don't work as well robotically
- Uniform cure requires understanding of lamp profiles
- Validation and measurement challenges require some sophistication
- Robotic curing is well suited to large or complex parts, flexible lines, and chemistry requiring high peak irradiance.

Thank You !

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www.uvrobotics.com

