

# Joe Carrow, Mechanical Engineer

System Design

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Simulation

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Injection Molding

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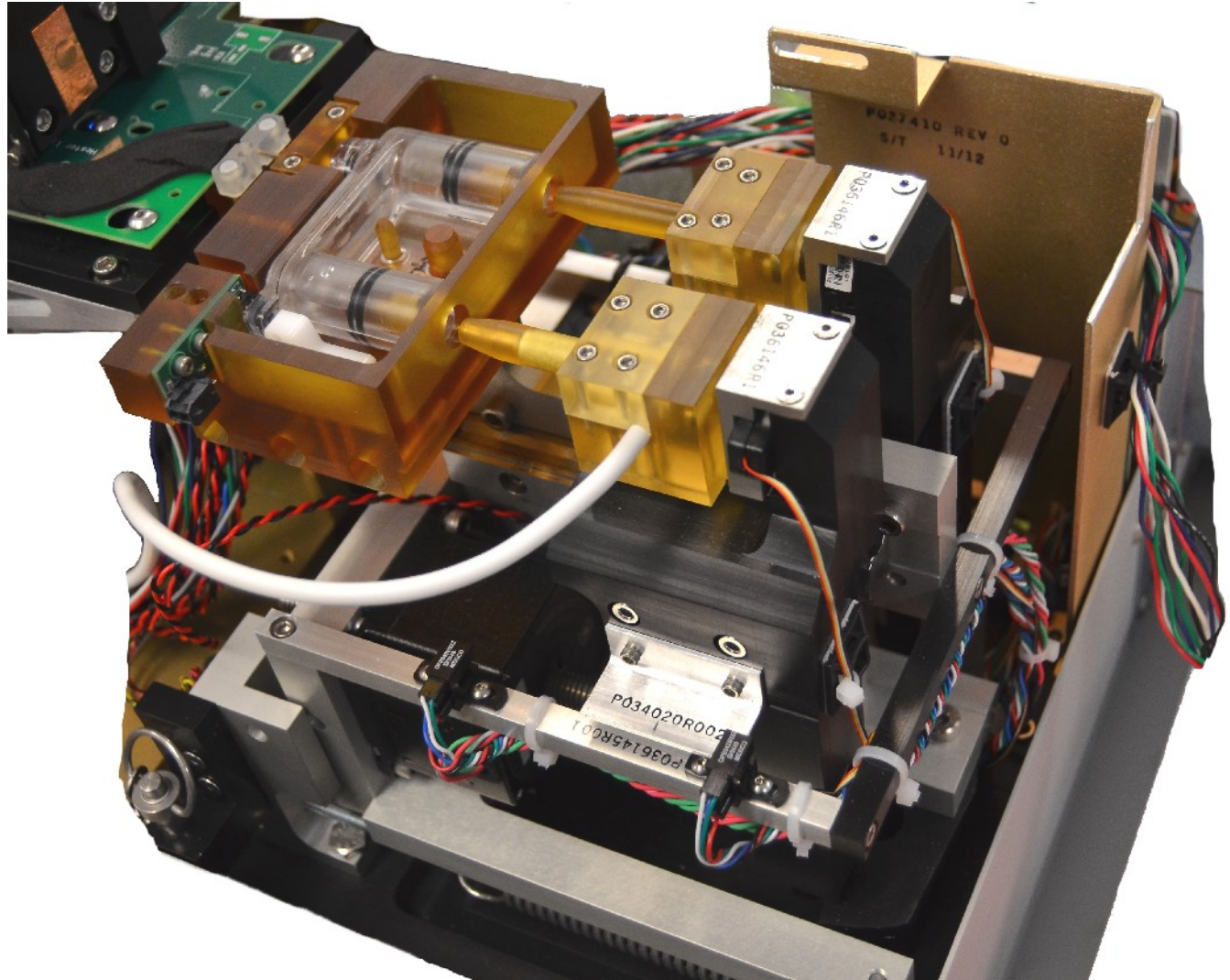
Human Factors

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Tooling

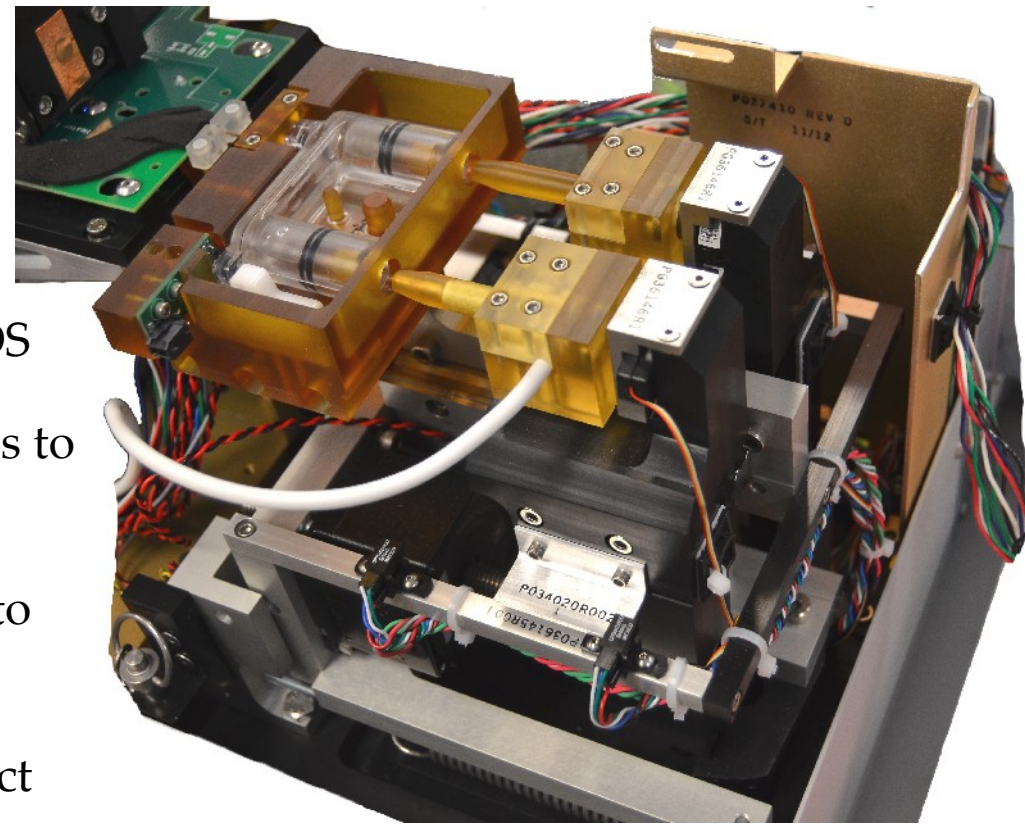
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Fabrication

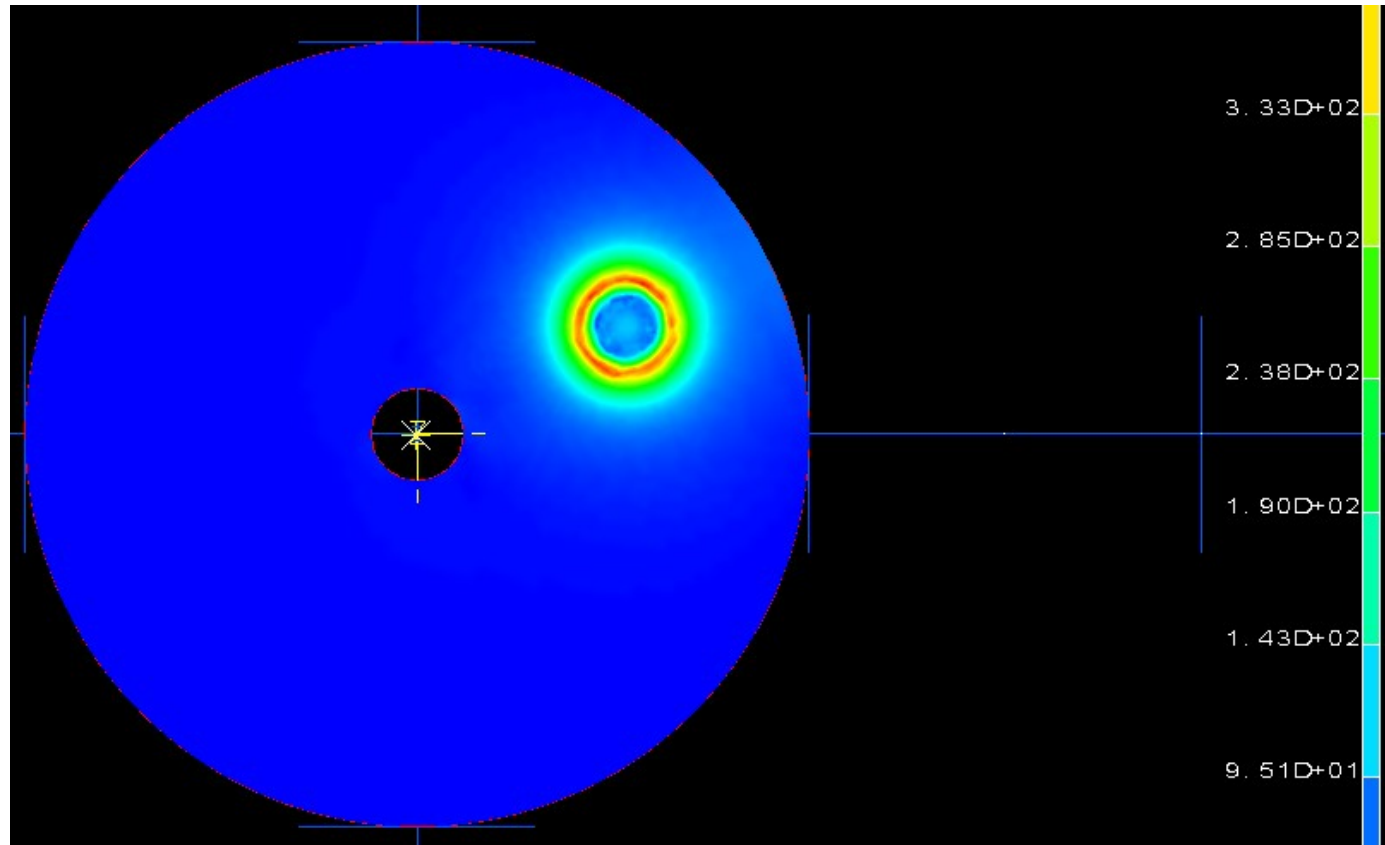


# Capillary Electrophoresis Separations Gel Handling for Automated Human DNA Identification Device

- Worked with scientists to define performance requirements of system
- Coordinated with sales and marketing, and industrial designers to define physical envelope of disposable cartridge and handling mechanism
- Fabricated proofs of concept to test physical processes and human factors concerns
- Designed plastic injection molded assembly
- Simulated all stressed components in COSMOS
- Worked with electrical and firmware engineers to achieve full automation
- Carried out accelerated life and overload test to failure.
- Documented system and handed off to contract manufacturer, ahead of schedule and under budget



# Simulation Examples

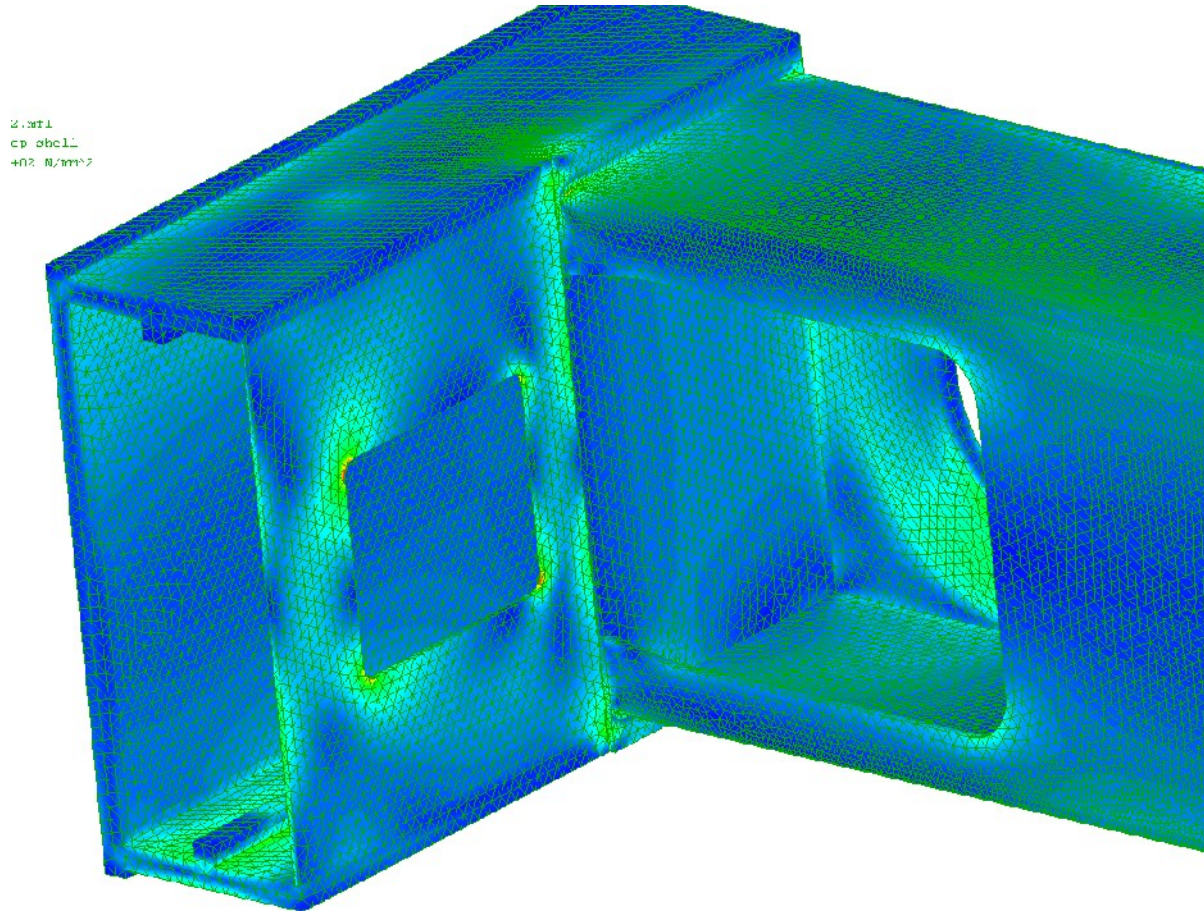


**Simulation of thermal shock load in X-ray target**  
*(Siemens Medical, I-DEAS)*

While investigating a new failure mode in a legacy product, I performed a **transient thermal simulation** to model stress due to thermal shock, and **steady state thermal analysis** to determine the cooling regime. My investigation showed that the X-ray target was exceeding a critical temperature for materials compatibility. I made recommendations to prevent reaching this temperature and identified a coating to prevent damage.



# Simulation Examples



**Simulation of Stress and Deflection in Welded Structure**  
*(Siemens Medical, I-DEAS)*

An existing welded gantry structure for a medical linear accelerator required modification to accommodate the addition of a flat panel imaging device. I **simulated stresses** to demonstrate **factors of safety in a medical environment**, and verified simulated values using strain gauges. I also simulated deflection prior to modifications to **mitigate risk**, and identified “worst case” test points to guide test efforts.

# Injection Molding Examples



**Microfluidic Manifolds** (*IntegenX, Inc, Solidworks*)

I used **3D rapid prototyping** to generate a proof of concept model to demonstrate bubble behavior and mating for two pieces in the **IntegenX RapidHIT200** human DNA identification device. **Prototype injection molding** allowed me to quickly refine the manifolds to reduce post-processing for assembly. The final product enabled blind mating of pneumatic and microfluidic connections by a minimally trained technician.



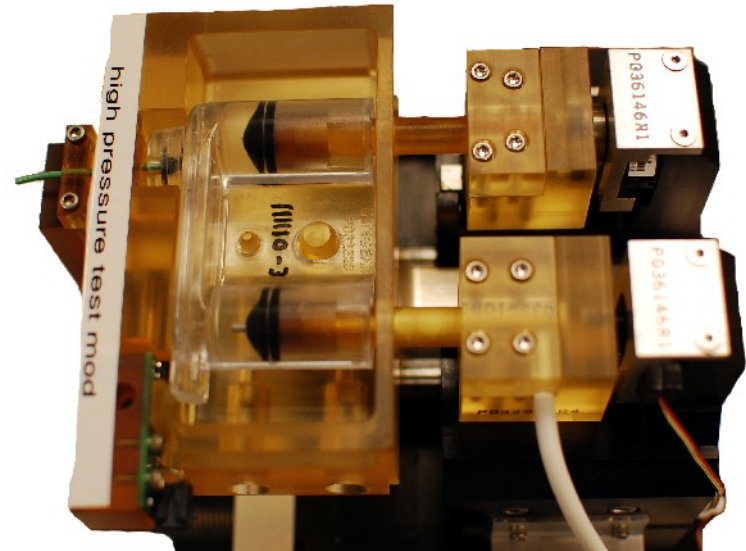
# Human Factors Examples



**Lever Powered Wheelchair**

*(Daedalus Wings, Inc, Solidworks)*

In designing the control scheme for a lever powered wheelchair, I performed **market research** to identify the disabilities most likely to be represented in the target market, and identified muscle groups most likely to be retained for safety critical control motions.



**Consumable CE Gel Cartridge**

*(IntegenX, Inc, Solidworks)*

I designed the IntegenX RapidHIT200 capillary electrophoresis gel cartridge to have an obvious “correct” orientation, protecting the high voltage and high pressure connections from improper loading. **“So easy a toddler could figure it out”** is feedback from the project's industrial design firm.

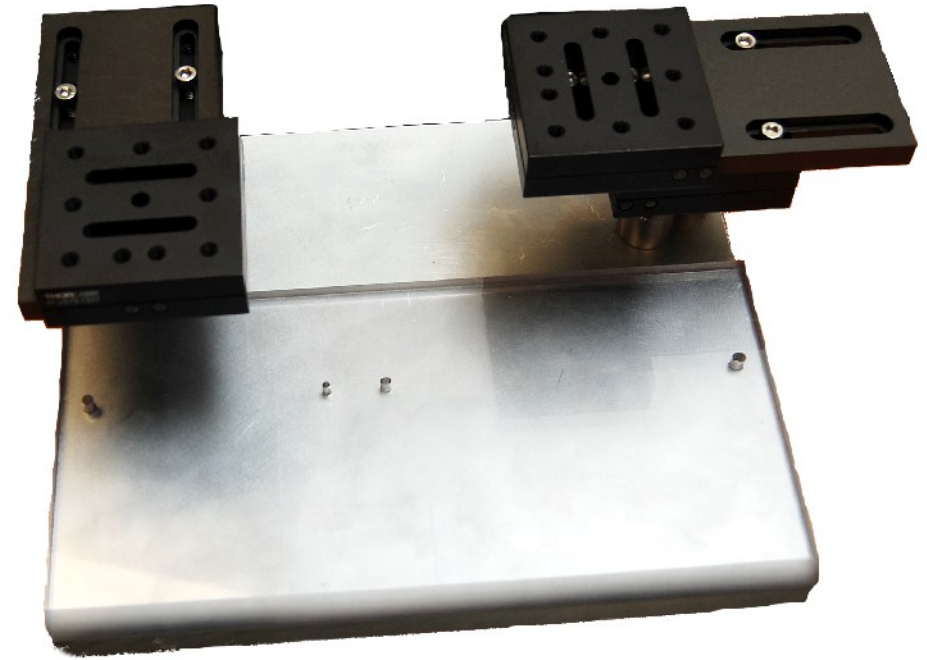
## Tooling Examples



**Vacuum Fixture for Microfluidic Chips**

*(IntegenX, Solidworks/Visualmill)*

This fixture allowed technicians to actuate pneumatic valves on a microfluidic chip during microscopic inspection, enabling new inspection and testing techniques. While creating this tool I operated the **Haas CNC Mini Mill** to create the mold for casting the sealing layer.



**Microscopic Inspection Work Area**

*(IntegenX, Inc, Solidworks)*

As IntegenX began producing a larger number of microfluidic chips in house, microfabrication department needed a way to rapidly reposition chips and digital microscopes. Using kinematic mounts and interchangeable locating jigs I was able to eliminate an hour per day of prep work in the clean room.



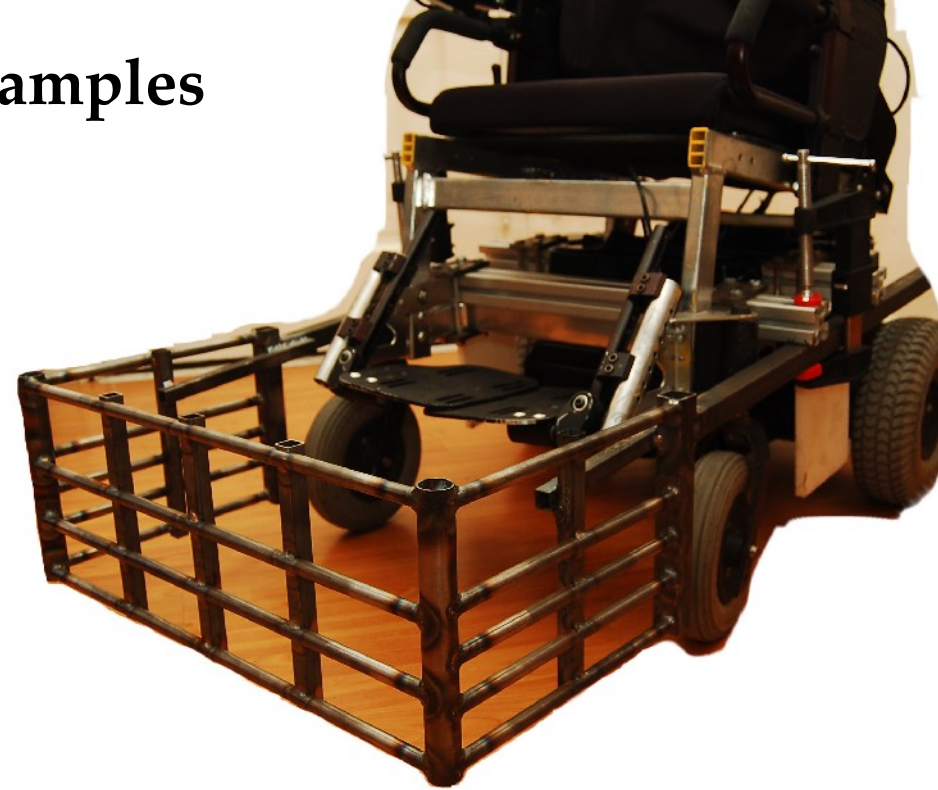
# Fabrication Examples



**Injection Mold for Microfluidic Chip**

*(IntegenX, Solidworks/Visualmill)*

I created tool paths and **Haas CNC Mini Mill** to create this injection mold for a microfluidic chip, accurately producing 100 micron channels and pneumatic valve seats.



**Power Soccer Foot Guard**

*(Personal, Solidworks)*

I designed this foot guard for a starter on the US National Power Soccer team. This design exceeded the stiffness of commercially available products while reducing the system's rotational inertia. I performed all metal fabrication on the guard used by this player while winning the World Cup.