Remote Experts Network Decision Support System (RENDSys)
CFD Analysis of LGH Internal Aerodynamics

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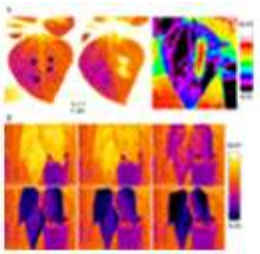
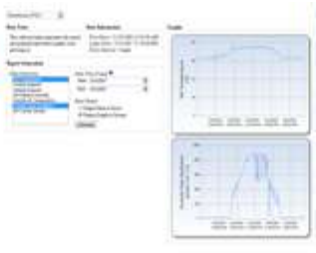
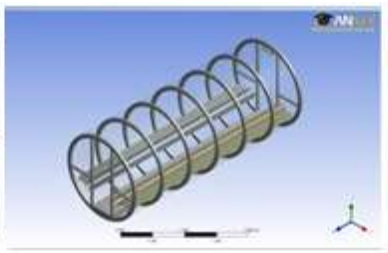
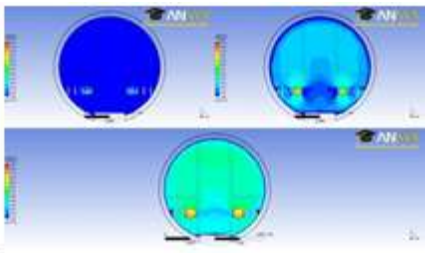
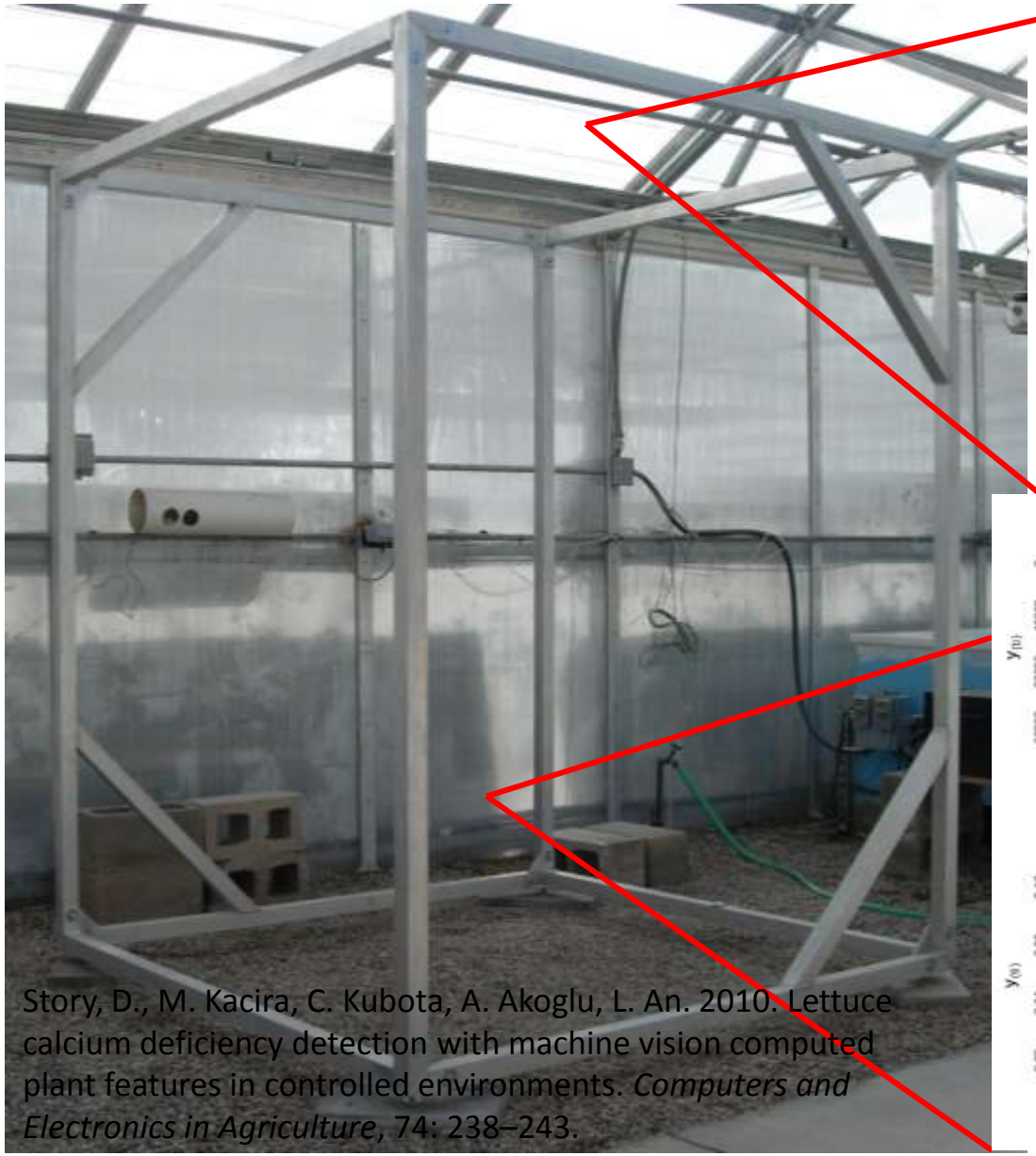





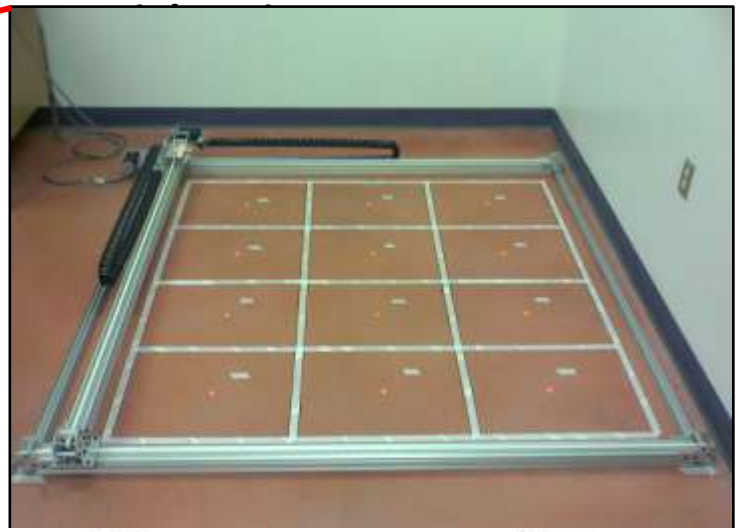
Remote Experts Network Decision Support System (RENDSys)

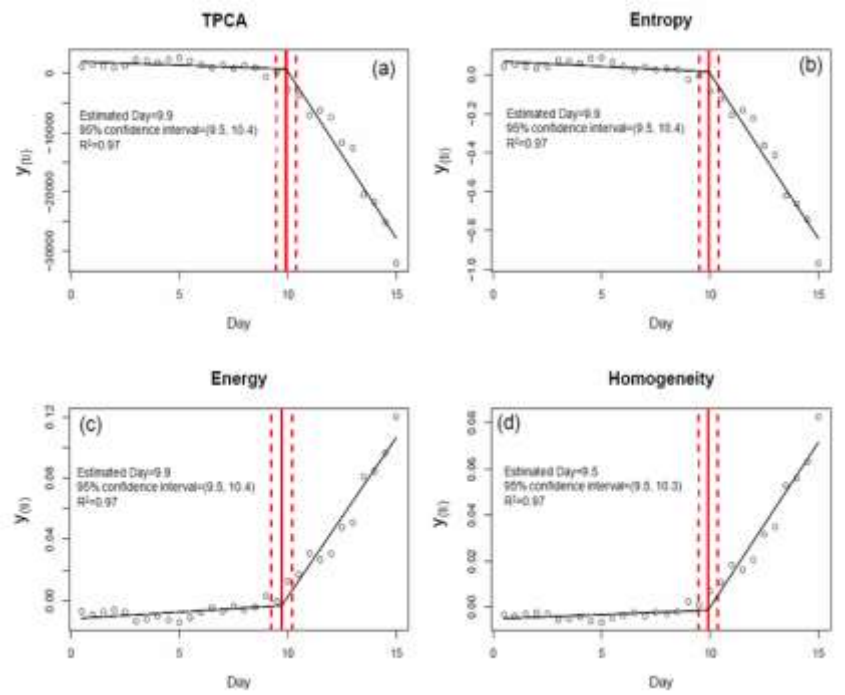
Objectives

- Design, develop and implement a machine vision guided multi sensor based crop health and growth monitoring system
- Develop a web based decision support platform for information acquisition, analysis, and support for LGH operational control

System Overview

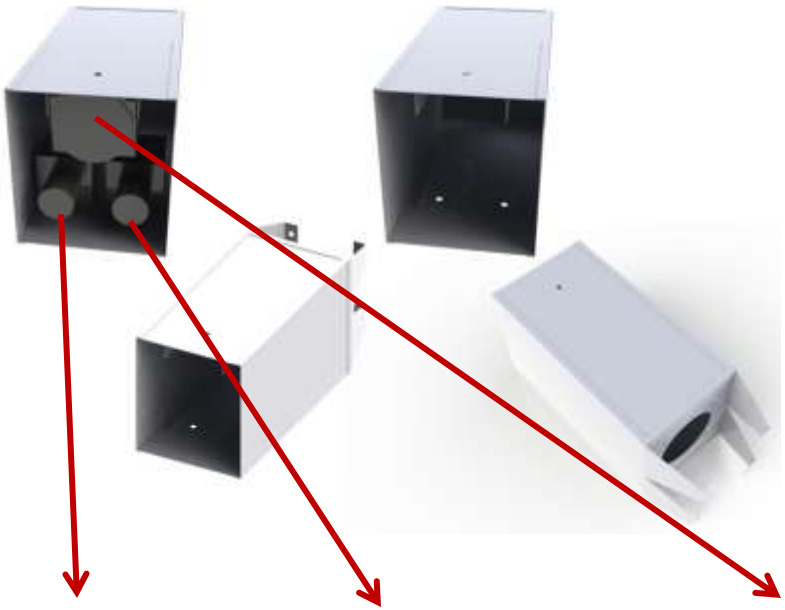






Story, D., M. Kacira, C. Kubota, A. Akoglu, L. An. 2010. Lettuce calcium deficiency detection with machine vision computed plant features in controlled environments. *Computers and Electronics in Agriculture*, 74: 238–243.

Tri-Camera System and Housing



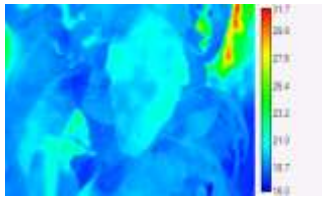
RGB

- RGB, HSL
- Morphology

NIR

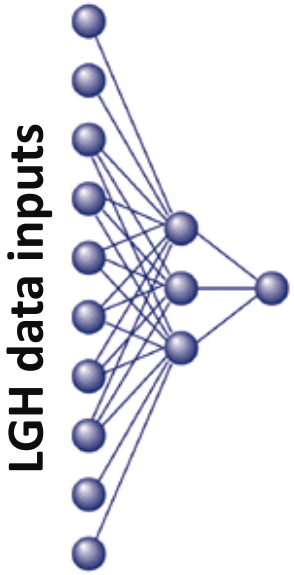
- Crop Indices

THERMAL



- Canopy Temperature

ANN



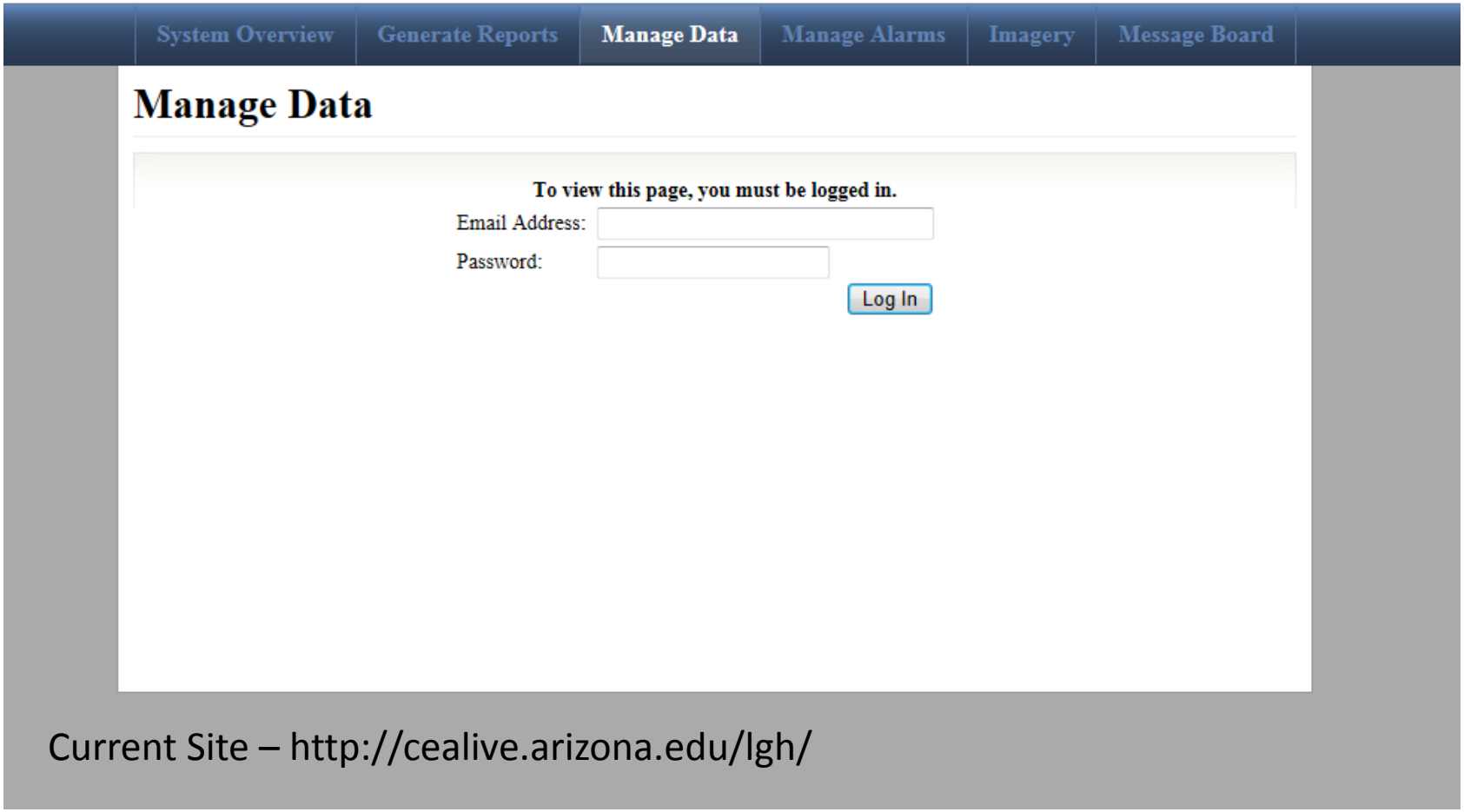
CEAC Greenhouse 2078-2

A closer look at this system will be given during today's tour

RENDSys Platform

CEAC
Controlled Environment Agricultural Center

LunarGreenhouse



Current Site – http://cealive.arizona.edu/lgh/

LUNAR GREENHOUSE RENDSys

Greenhouse 2078-2

Data Notes

The collected data represents the aerial environment that lettuce plants were growing in.

Data Information

First Entry: 12/19/2006 12:03:00 AM
Latest Entry: 3/24/2007 11:58:00 PM
Entry Interval: 5 (min)

Report Generation

Data Selections

- GH Temperature
- Cooling Setpoint
- Heating Setpoint
- GH Relative Humidity
- Outside Air Temperature
- Outside Solar Radiation
- GH Carbon dioxide

Data Time Frame

Start: 3/24/2007
End: 3/24/2007

Data Output

- Output Data to Excel
- Output Graph to Screen

Generate

[Still] [Live]

Graphs

LUNAR GREENHOUSE RENDSys

Welcome David [Logout]

LGH System Overview | Graphical Data | Resource Input / Output | **Live Imagery** | Alarms | Blog

Date

07/18/2012

Crop Monitor Database

- Biomass production
- RGB
- Texture [Energy, Entropy, Homogeneity]
- Thermal Image [Stresses]
- Temporal

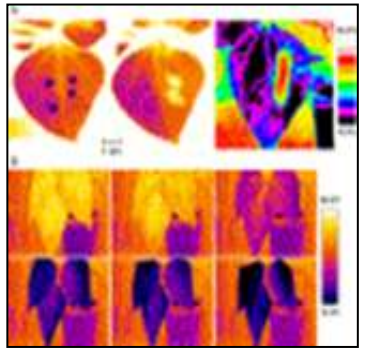
Model Databases

- Neural Network
- Mechanistic

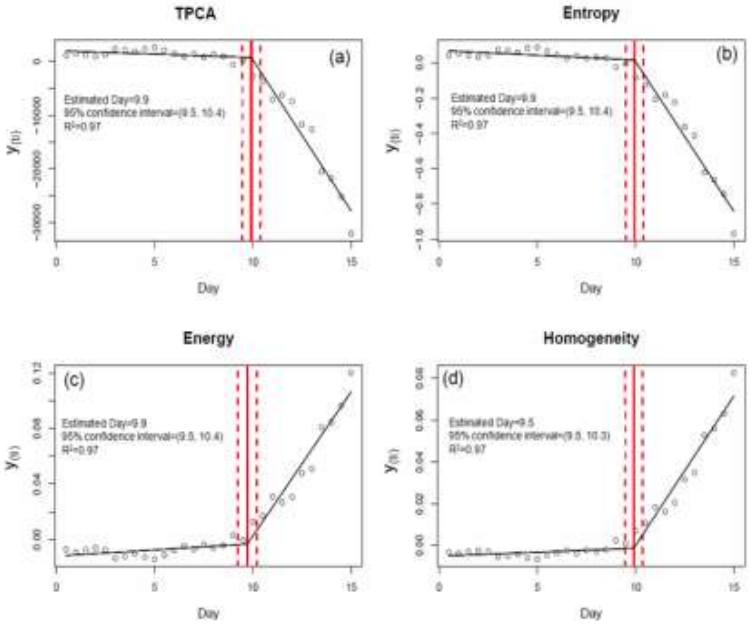
View Data

[Still] [Live]

[Still] [Live]



[Crop Health]



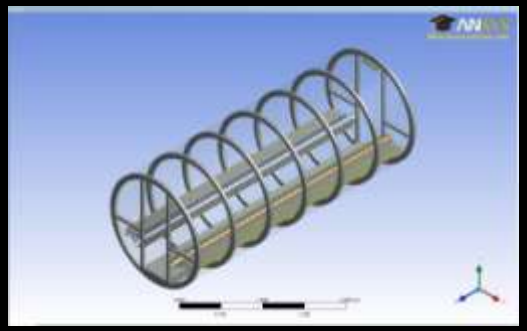
Ongoing efforts

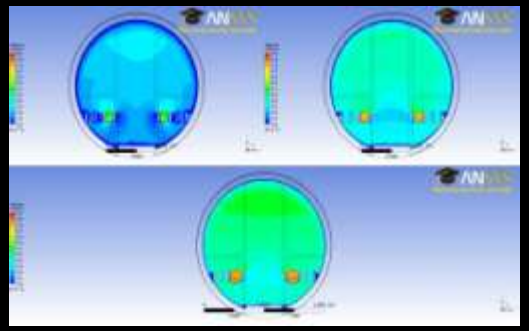
- Image Stitching - To generate panoramic canopy images
- Image Processing – Analyze images for crop health/growth characteristics and store within databases
- Assembling of the whole system in GH for experiments
- RENDSys
  - Add to existing platform to allow remote accessibility to LGH data
  - Enhance site functionality

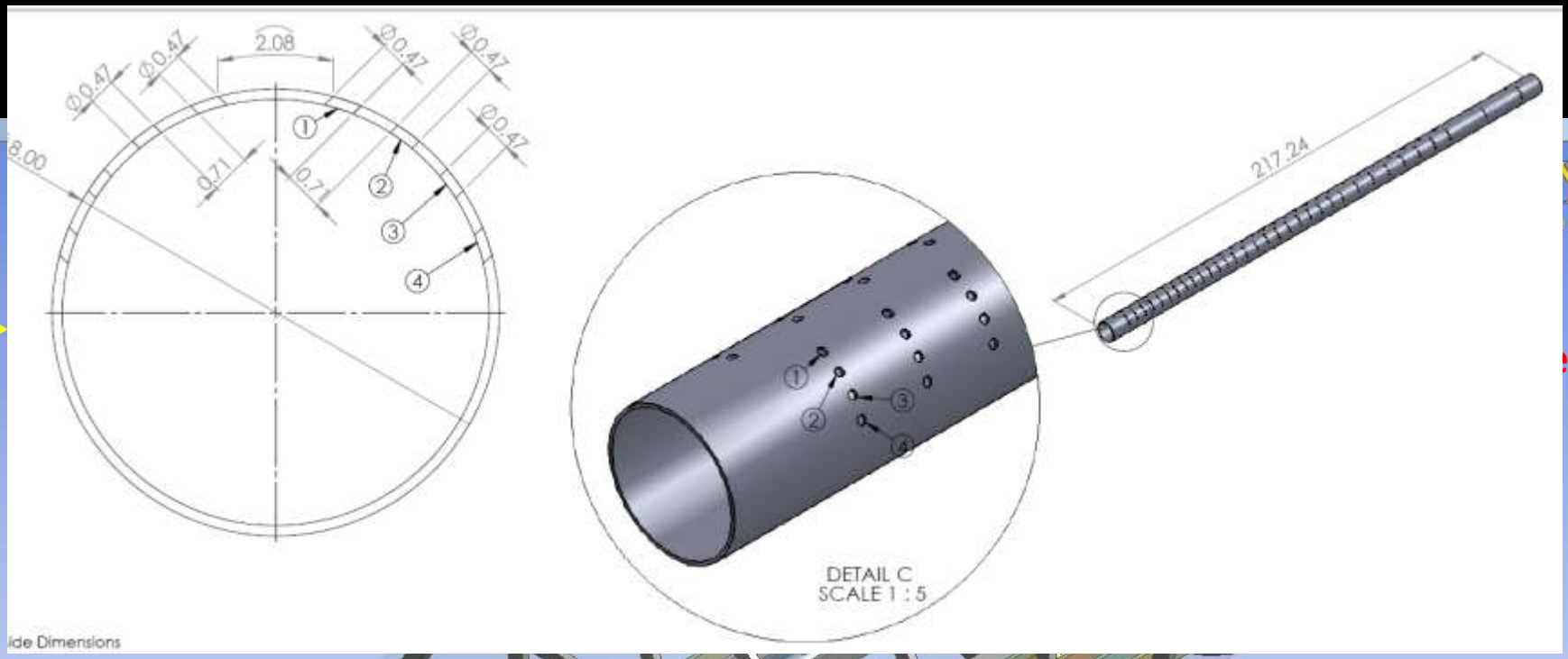
Computational Fluid Dynamics (CFD) Analysis of LGH Internal Aerodynamics

Objectives

- Analyze airflow and climate uniformity in the LGH system
- Improve climate uniformity with revised air distribution tube



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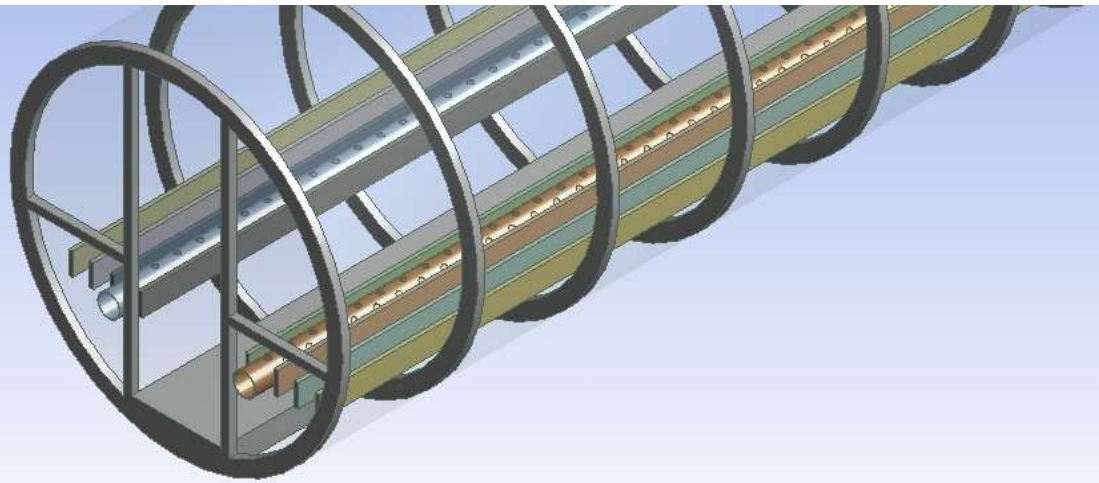


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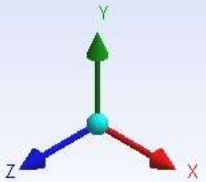
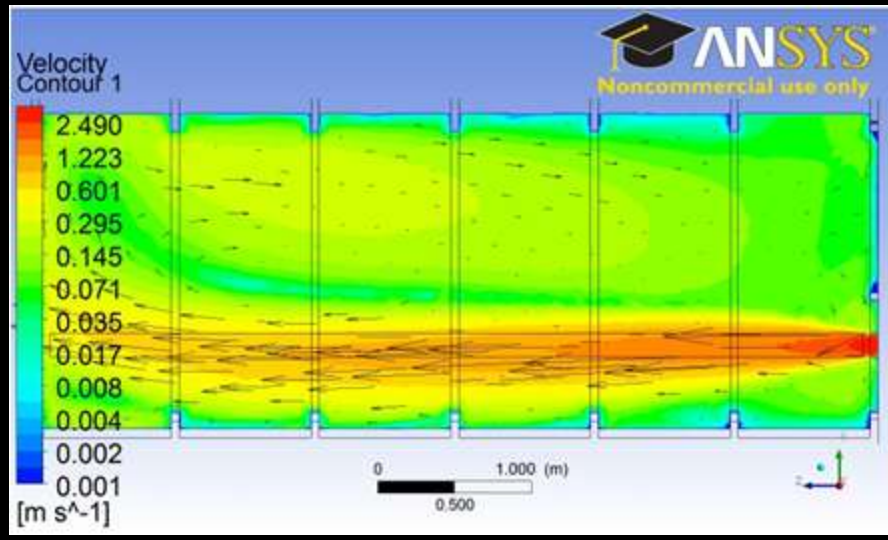
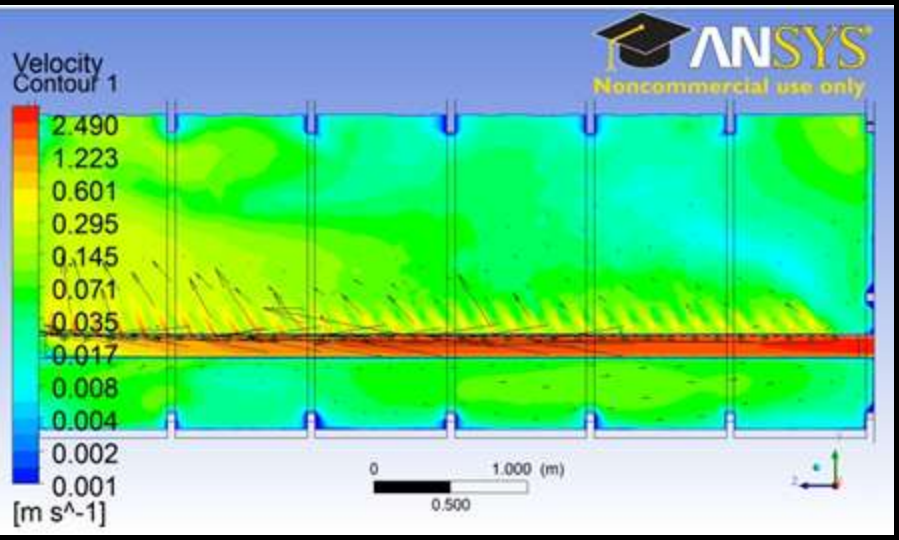
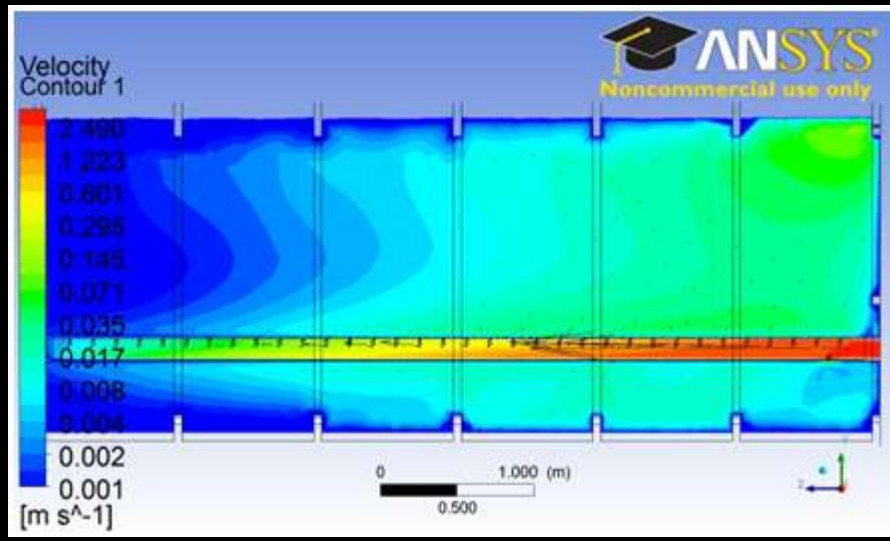

Y
Z
X

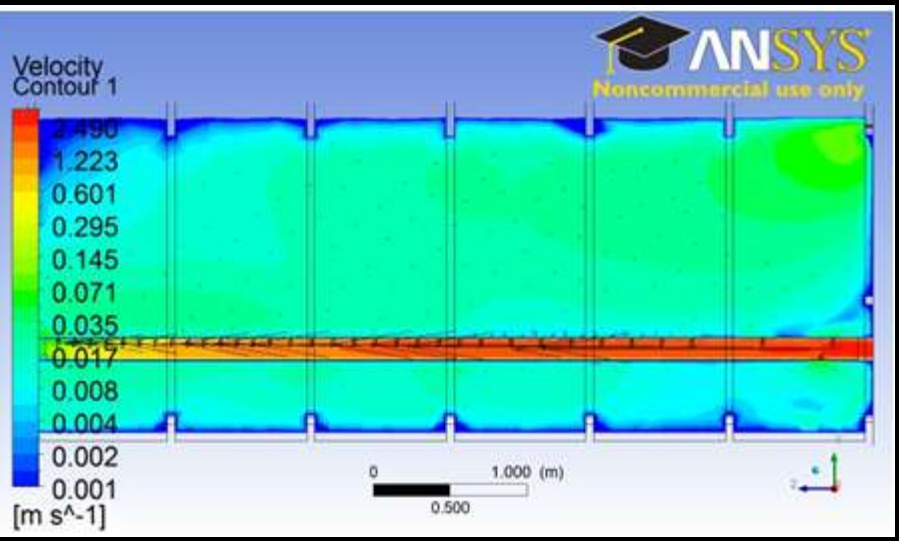
No Air Tubes

With Original Air Tubes



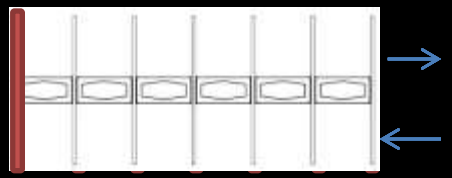






Airsoft – Equal Spaces

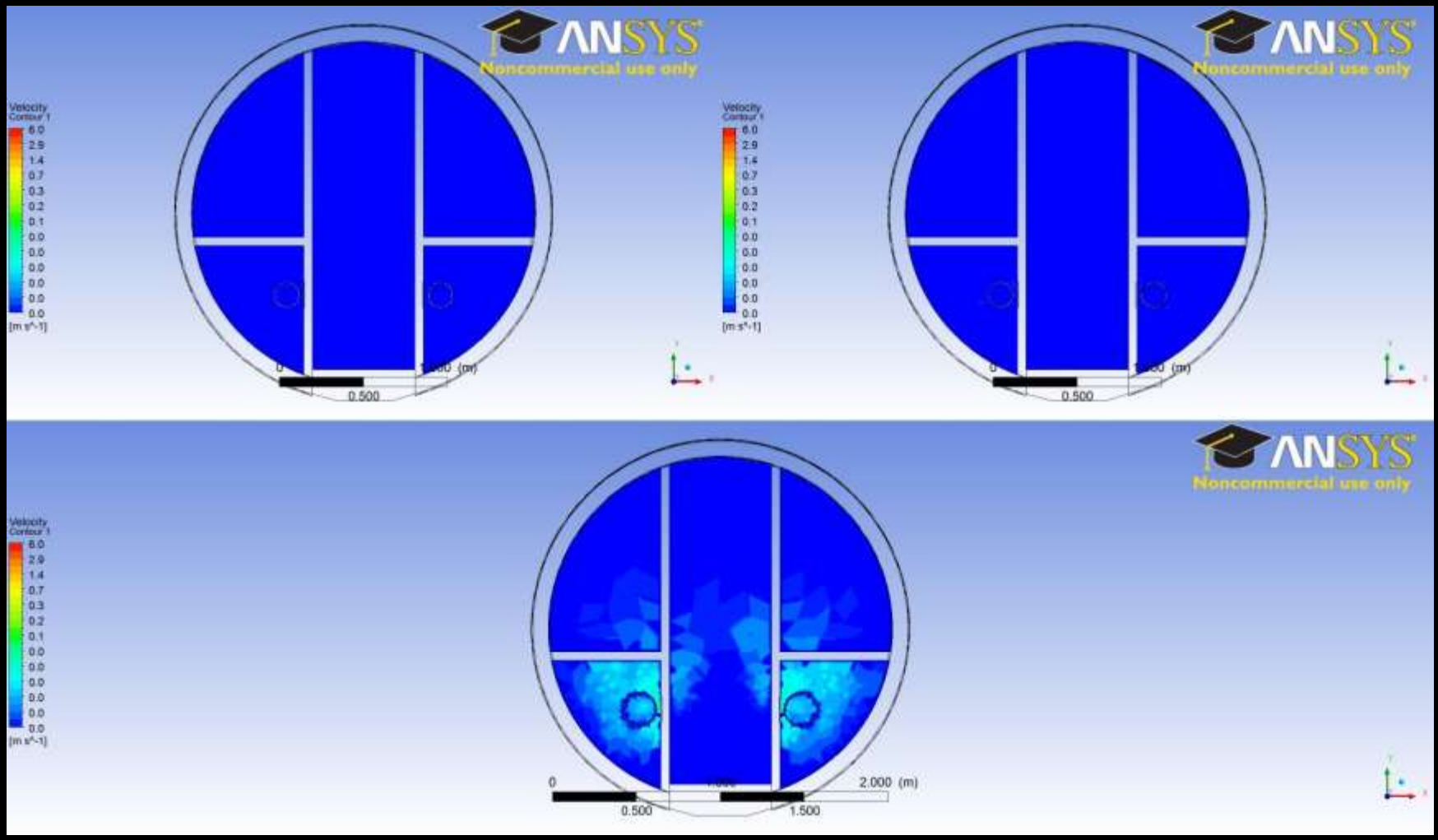
Airsoft – Uneven Spaces



Airflow uniformity

With Current Tubes

Airsoft – Uneven Spaces (6” ID Inlet)



Airsoft – Uneven Spaces (8” ID Inlet)

THE UNIVERSITY OF ARIZONA. http://ag.arizona.edu/lunargreenhouse/

UA CONTROLLED ENVIRONMENT AGRICULTURE CENTER

Prototype Lunar Greenhouse

A NASA STECKLER SPACE GRANT COLLABORATION

The Prototype Lunar Greenhouse (LGH)
is equipped as a Bioregenerative Life Support System (BLSS) through the design and construction of an innovative hydroponic plant growth chamber. Centered on using plants to sustain a continuous vegetarian diet for astronauts, a typical BLSS employs plants and crop production in addition for food, to also provide air revitalization, water recycling, and waste recycling for the crew. Fulfilling the requirement of NASA's GES and the late Mr. Steckler's dream of space colonization, the LGH aims to deliver more than supporting a sustained human presence in space. The LGH aspires to bring practical commerical-ready technology to Earth's CEA forefront.

(2009) LGH Chamber 1 Full of plants

Lunar Greenhouse Lab Webcam

Click Here to view the webcam live!

Photo Gallery

Recent Publications

Peer Reviewed Journal Article

Boscheri, G., M. Kacira, L. Patterson, G. Giacomelli, P. Sadler, R. Furfaro, C. Lobascio, M. Lamantea, L. Grizzaffi. 2012. Modified energy cascade model adapted for a multicrop lunar greenhouse prototype. ***Advances in Space Research***. http://dx.doi.org/10.1016/j.asr.2012.05.025. (***In Press***)

Peer Reviewed Conference Proceedings Papers

Giacomelli, G., R. Furfaro, M. Kacira, L. Patterson, D. Story, P. Sadler, G. Boscheri, C. Lobascio, M. Pirolli, R. Remiddi, M. Thangavelu, M. Catalina. 2012. Bio-regenerative Life Support System Development for Lunar/Mars Habitats. 42nd Int. Conf. on Environmental Systems, July 15-19, San Diego, California. (***Accepted***)

Kacira, M., G. Giacomelli, L. Patterson, R. Furfaro, P. Sadler, G. Boscheri, R. Wheeler, C. Lobascio, M. Lamantea, S. Rossignoli. 2011. System dynamics and performance factors of UA-CEAC lunar greenhouse prototype bioregenerative life support system. ***ActaHorticulturae***. (***In Press***)