Utilizing the MADe Modeling Tool

Youngjo Lim & Tony Odita

Morgan State University

Advisor: Dr. Guangming Chen

Morgan State University

Co-Advisors: Luis Gallo & Mahdi Alimardani

NASA Goddard Space Flight Center

Research Goals

Reliability Analyses (FMEA, FMECA, Reliability Predictions, FTA, CIL)

- Efficiently re-usable.
  - Library of common Spacecraft subsystems and components
- Develop standardized formats
- Relate to systems engineering models.
- Verify consistency.

Why use MADe?

- What is it?
  - A modeling tool that allows users to generate a variety of analyses across different engineering domains.
  - Currently has 3 modules (SRA, RAM, PHM).
- What can it do?
  - Design & Safety: FMEA, FMECA, FTA
  - Reliability & Availability Engineering: RBD Analysis
- Why is it useful to us?
  - Pre-formatted reports
  - One file vs Multiple files
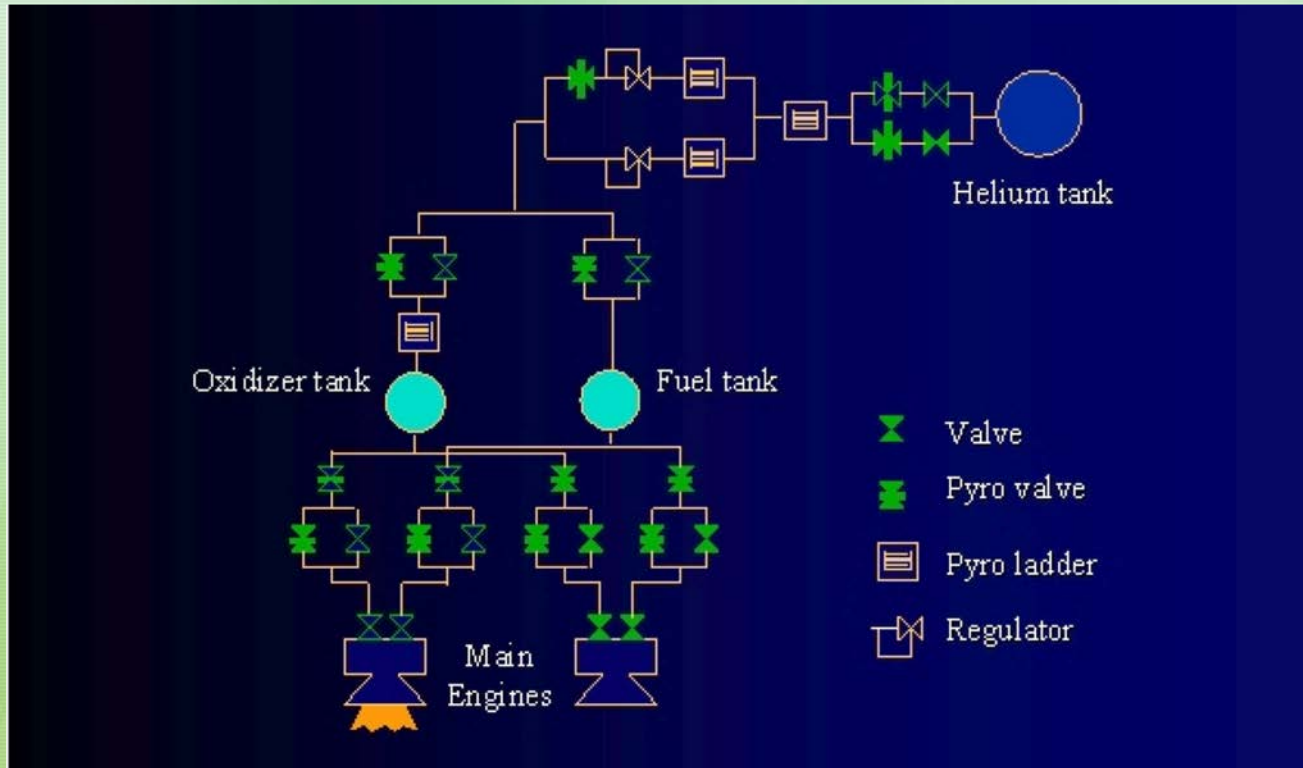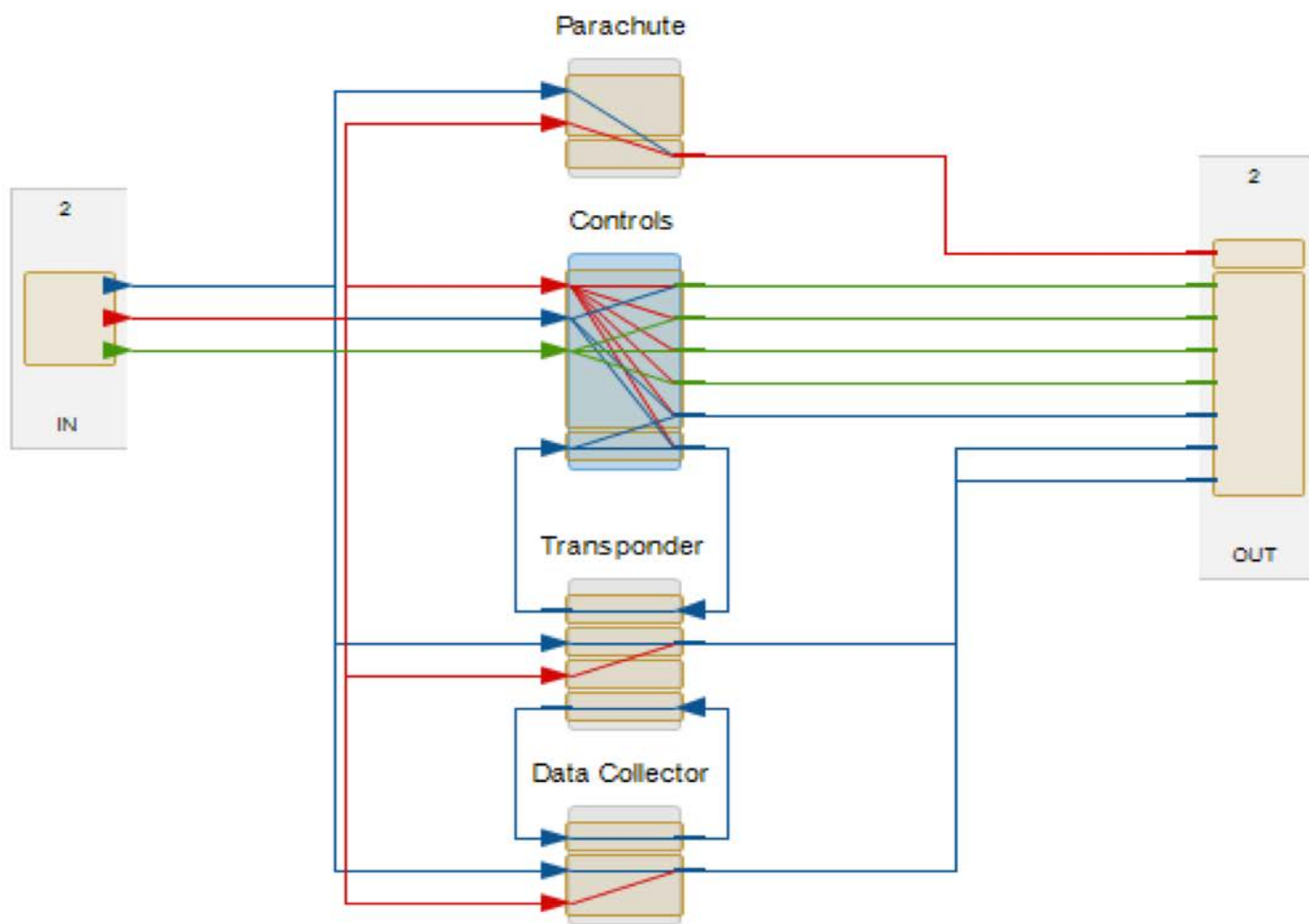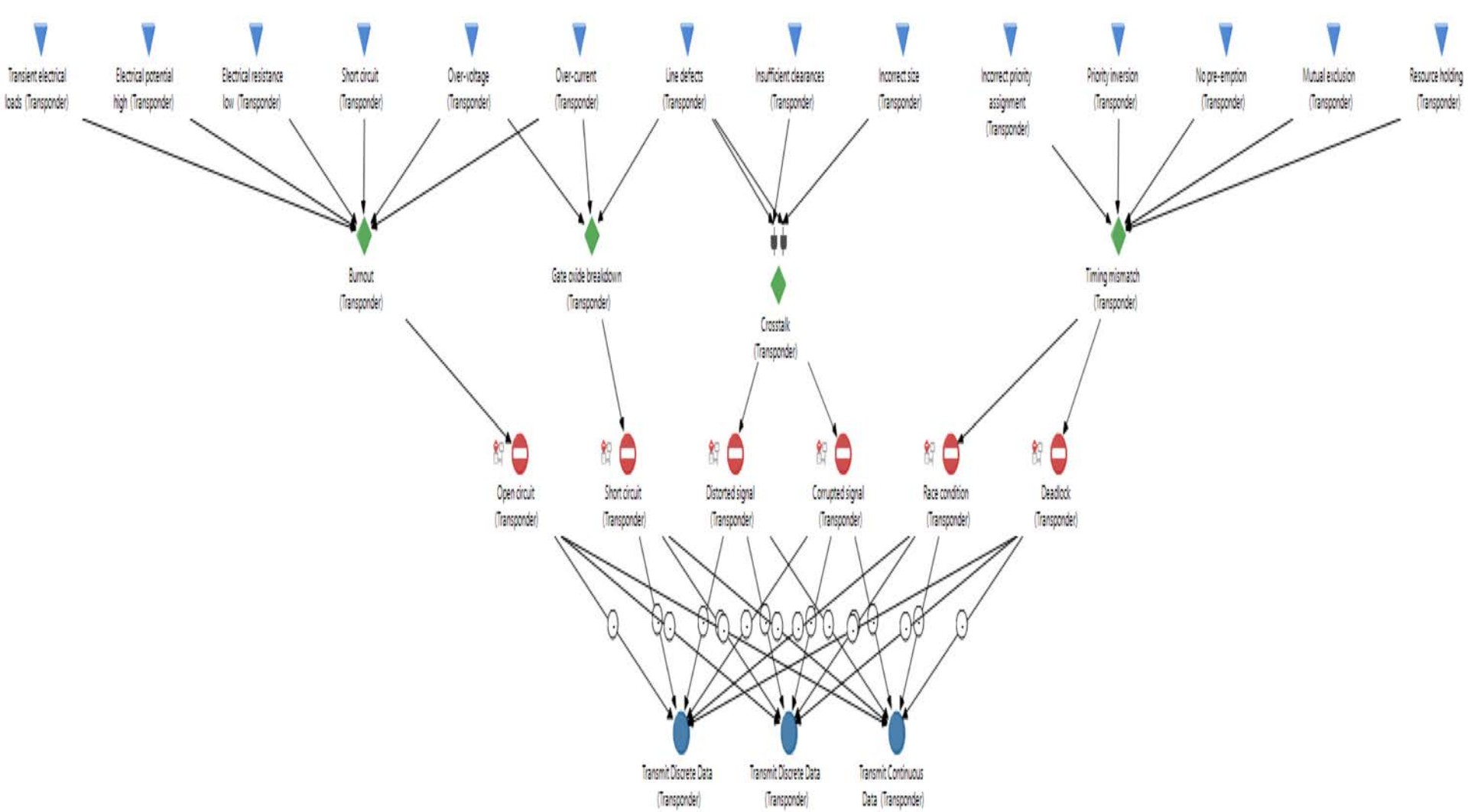 - Vast and available resources (palette, library)
  - Versatile.

Radar Tracking Beacon

Telemetry Antenna

Attitude Control

Recovery

Firing/Despin

Rocket Motor

Experiment

Nose Cone

EXPERIMENT

PAYLOAD

ROCKET MOTOR

Schematic Diagram

Figure 3: Propulsion System

Controls

A component failed — Series Group

A component failed — Space Altitude Control

A component failed — Series Group

A component failed — Series Group
- Component failure — Battery
- Component failure — Power Relay

A component failed — Series Group
- Component failure — Command Uplink
- Component failure — Airborne Computer
- Component failure — Telemetry Interface

All components failed — Parallel Group
- Component failure — Star Tracker
- Component failure — IMU

A component failed — Series Group
- Component failure — Tank
- Component failure — Plumbing
- All components failed — Parallel Group
  - Component failure — Pitch Valve
  - Component failure — Roll Valve
  - Component failure — Yaw Valve
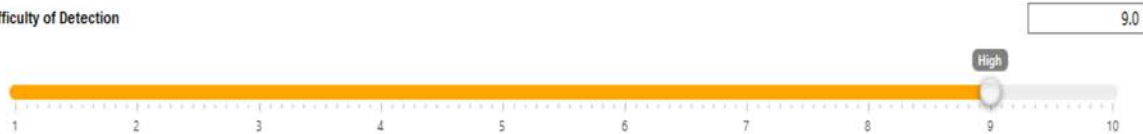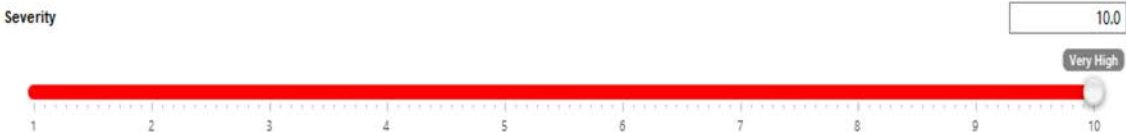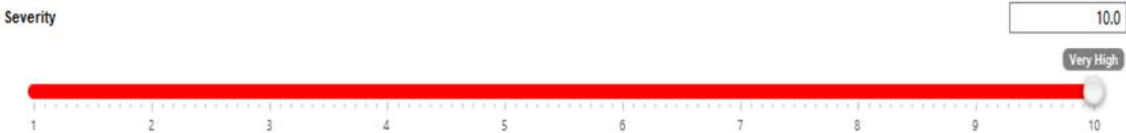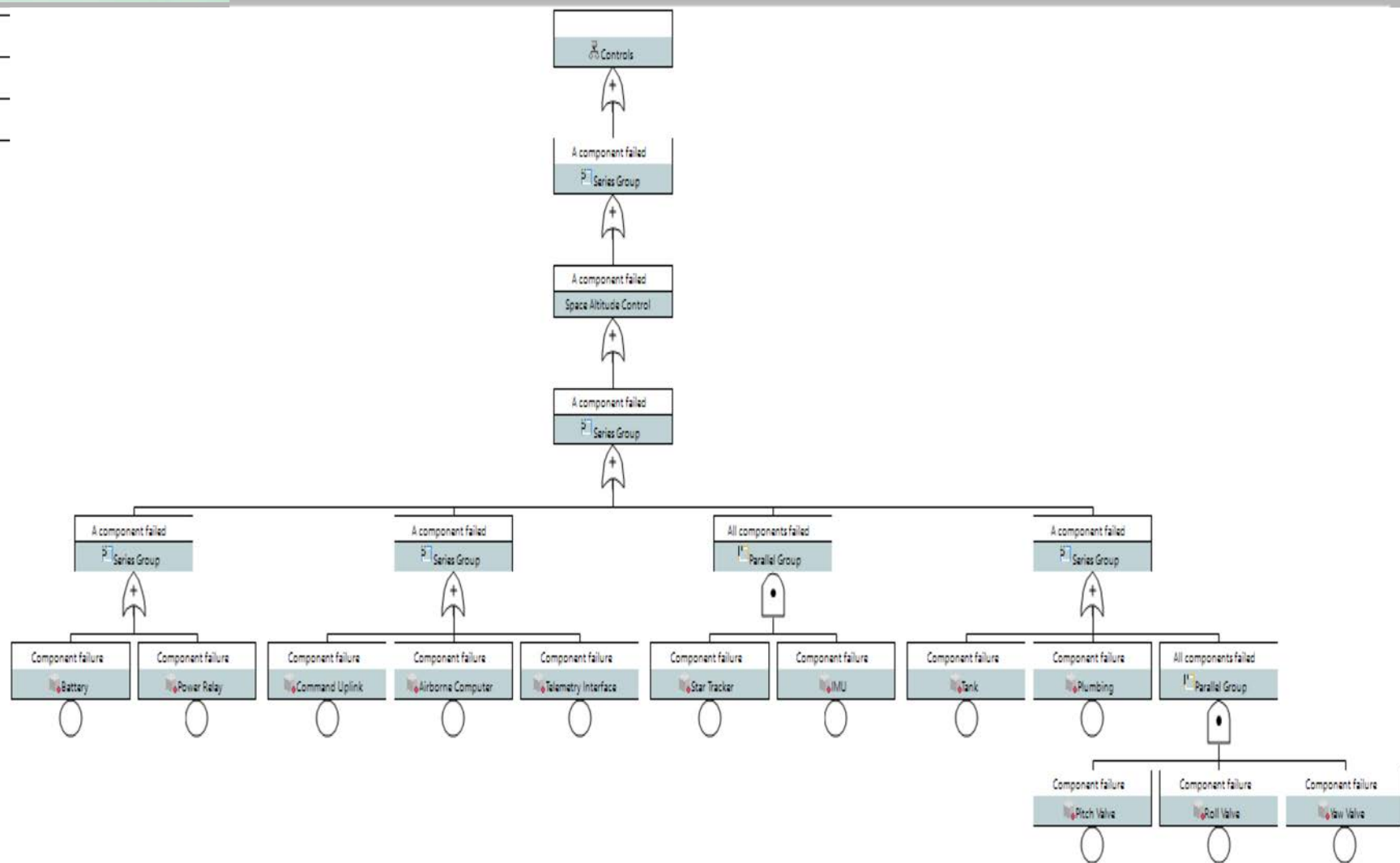
Challenges/Lessons Learned

- Navigation/Complexity Issues
- Continued development of Reliability Analyses in Aerospace.

- High importance in meeting regulation standards.
- Broaden the scope of describing and understanding component failures and faults due the library of failure causes and mechanisms.
- Modeling tool's vast potential.

References

Doody, D & Stephan, G. (1995, December). Basics of Space Flight Learners' Workbook. *Jet Propulsion Laboratory, California Institute of Technology.* Retrieved from https://er.jsc.nasa.gov/seh/spaceflt.pdf

Marconi, E. M. (2007, November 22). What is a Sounding Rocket? *NASA's John F. Kennedy Space Center and Wallops Flight Facility*. Retrieved from https://www.nasa.gov/missions/research/f_sounding.html

Williams, B & Nayak, P. (n.d.). *Model Based Autonomous Systems* [PowerPoint slides]. Retrieved from https://courses.cs.washington.edu/courses/csep573/98sp/lectures/lecture3/sld026.htm

Acknowledgements

The authors would like to thank the following people for their support.

- Nancy Lindsey   GSFC Risk & Reliability Branch Chief

- Mahdi Alimardani   GSFC Reliability Engineer

- Luis Gallo   GSFC Reliability Engineer

- Guangming Chen   Ph.D., MSU Professor, Graduate
                         Program Coordinator and Director of SEMI