



A MULTIPLE-FIDELITY, MULTIPLE-BODY, END-TO-END, ENTRY DESCENT AND LANDING (EDL), SIMULATOR FOR GNC DESIGN, VERIFICATION AND VALIDATION.



**Presented by:**

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Presenting EAGLE for STFC Kite Club



# Contents

- What is GNC
- What is our approach?
- Why is it different?
- Who is the target user?
- Future Directions
- Questions

# What is **GNC**?

- **G**uidance

- ⇒ Provides a path to follow, can be human generated or created autonomously, how to get from A to B.

- **N**avigation

- ⇒ Uses sensor information to build a picture of the real world at discrete intervals of time.

- **C**ontrol

- ⇒ Uses the navigation and guidance information to command the system to achieve goals.

- **E**xamples:

- ⇒ Car satellite navigation system.

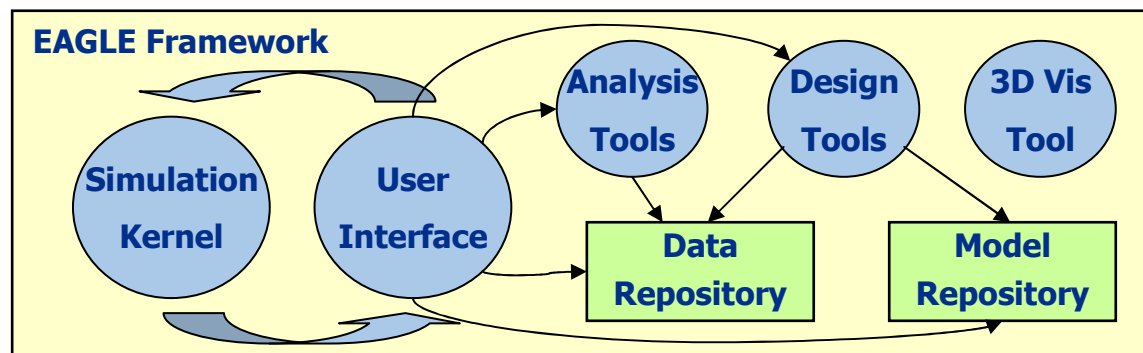
- ⇒ UAV flight control system.

- ⇒ Spacecraft Entry Descent and Landing system.



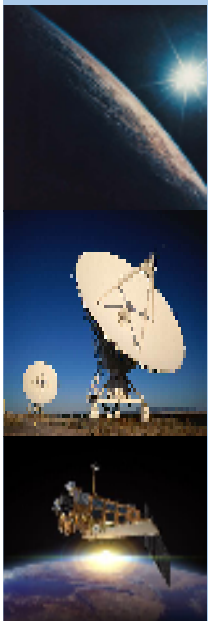
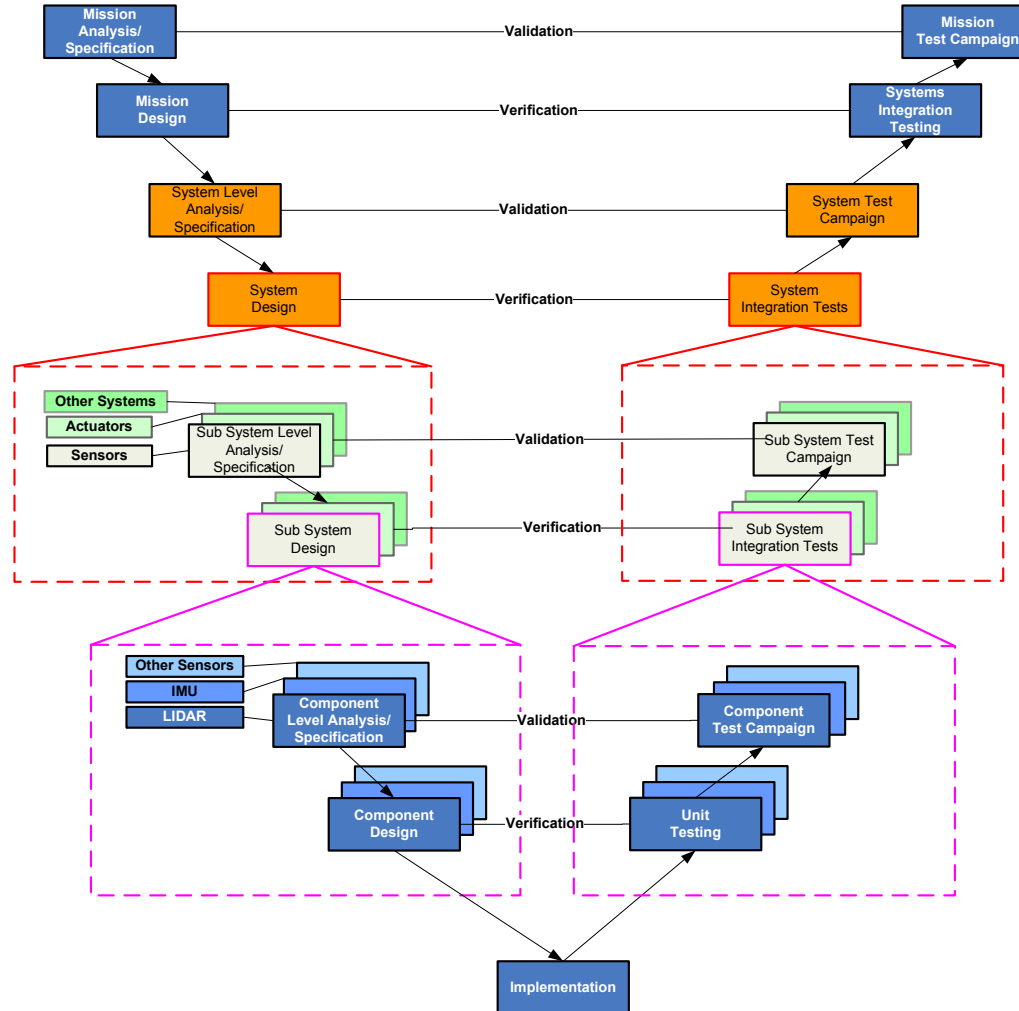
# What is our approach?

- Framework to design, develop and test Guidance, Navigation and control algorithms.
- Main stakeholder is European Space Agency, using the tool for GNC design for missions on Mars, Moon and Earth
- Uses component based architecture.
- Matlab as a core simulation kernel.
- Separate cross platform Graphical User Interface.
- Database connections to persist data.
- Model repository for library of models and configuration management.
- Analysis and Design tools specific to user domain.
- Visualisation tool for 3D visualisation during simulation and post simulation.



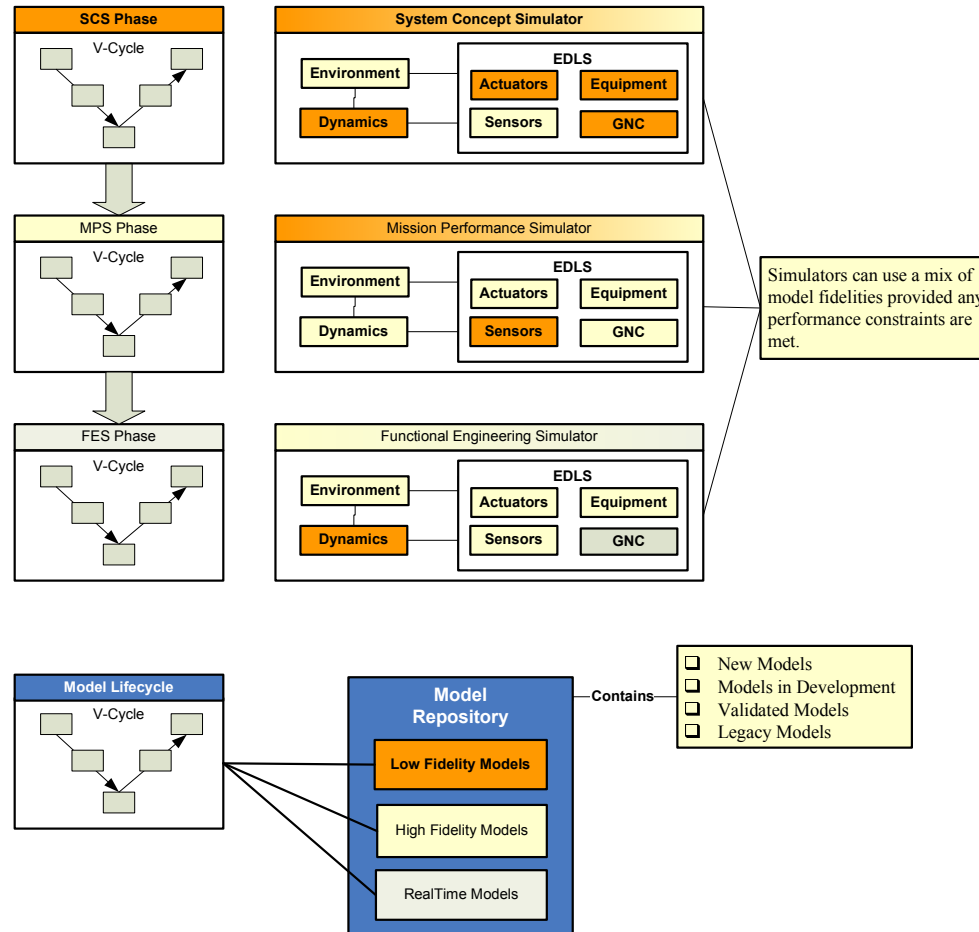
# Why is it different?

- Supports full design lifecycle...



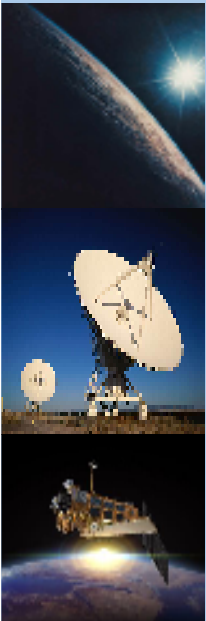
# Why is it different?

- ...and the full mission lifecycle.



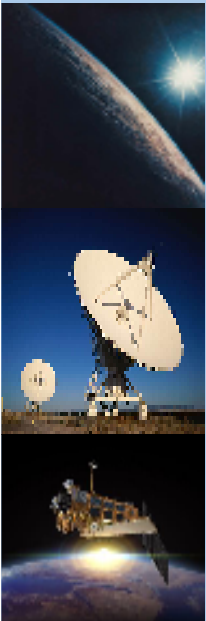
# Why is it different?

- From initial concept to hardware in the loop testing.
- From start of mission to end of mission
  - ⇒ no need to break analysis into sections.
- Physics based simulation
  - ⇒ Allows modelling of virtually any system.
- Multiple Fidelity
  - ⇒ Mix and match models to meet simulation needs.
- Based on open source and COTS products
  - ⇒ Eclipse
  - ⇒ Matlab
  - ⇒ MySQL
  - ⇒ Hibernate
- Open extensible architecture.



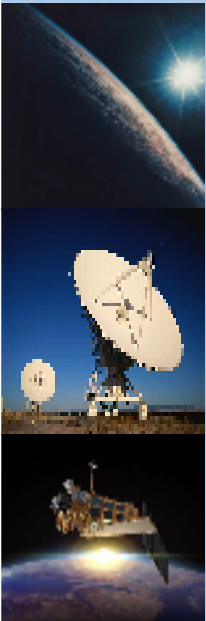
# Who are the target users?

- GNC Engineers
  - ⇒ Algorithms prototyping, maturing TRL, hardware testing.
- System Designers
  - ⇒ Equipment choices, trade-off studies, performance analysis.
- Mission Designers
  - ⇒ Mission concept, multiple system interactions, task optimisation.
- Test and Analysis Teams
  - ⇒ Validation and verification
- Allows users with domain specific knowledge to focus on specialist area.
- Provides an integration and test environment for the model, system and mission levels.
- Faster design iteration and increased productivity!

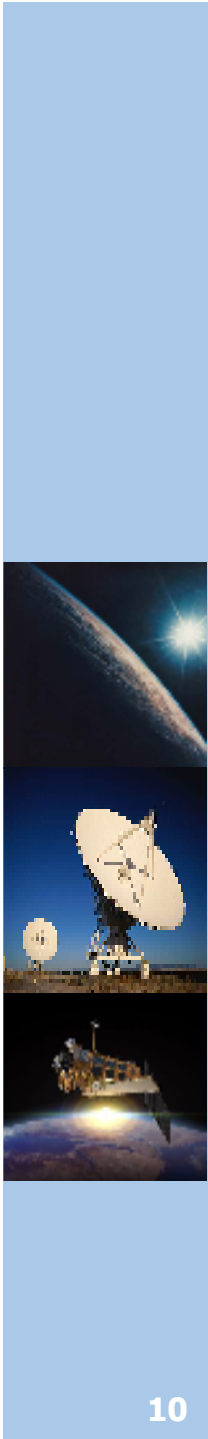


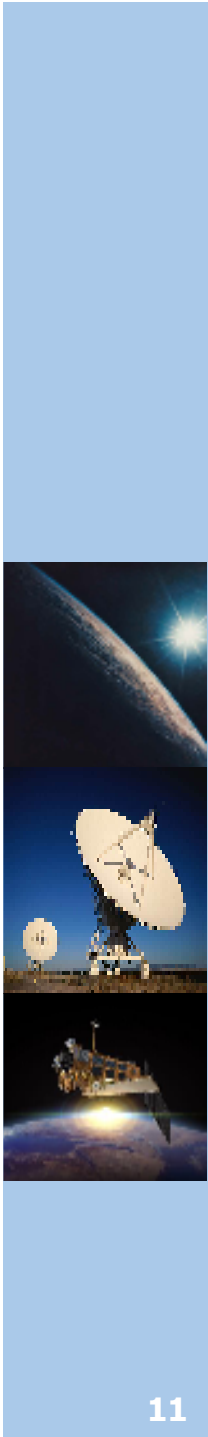
# Future Directions

- Investigations to replace Matlab with an open source alternative (SciLab, Octave..)
- Collaboration workspace for user interface, using web technologies.
- Provide alternative hardware in the loop capabilities, using real time Linux kernel (Ubuntu).
- Demonstrate cross sector applications
  - ⇒ Aircraft
  - ⇒ Submersibles
  - ⇒ Balloons
- Demonstrate multiple environments
  - ⇒ Land
  - ⇒ Sea
  - ⇒ Air



# Questions





**Thanks!**