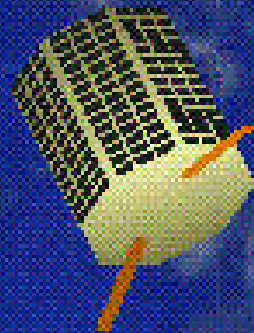


Guidance, Navigation and Controls Subsystem



Winter 1999 Semester Review

Guidance, Navigation, and Controls

Outline

- Team Overview (Greg Chatel)
- Attitude Determination (David Faulkner)
- Attitude Control (Brian Shucker)
- Simulations (Barry Goeree)



Team Members

Team Mentor:

- Dr. Fasse (AME)

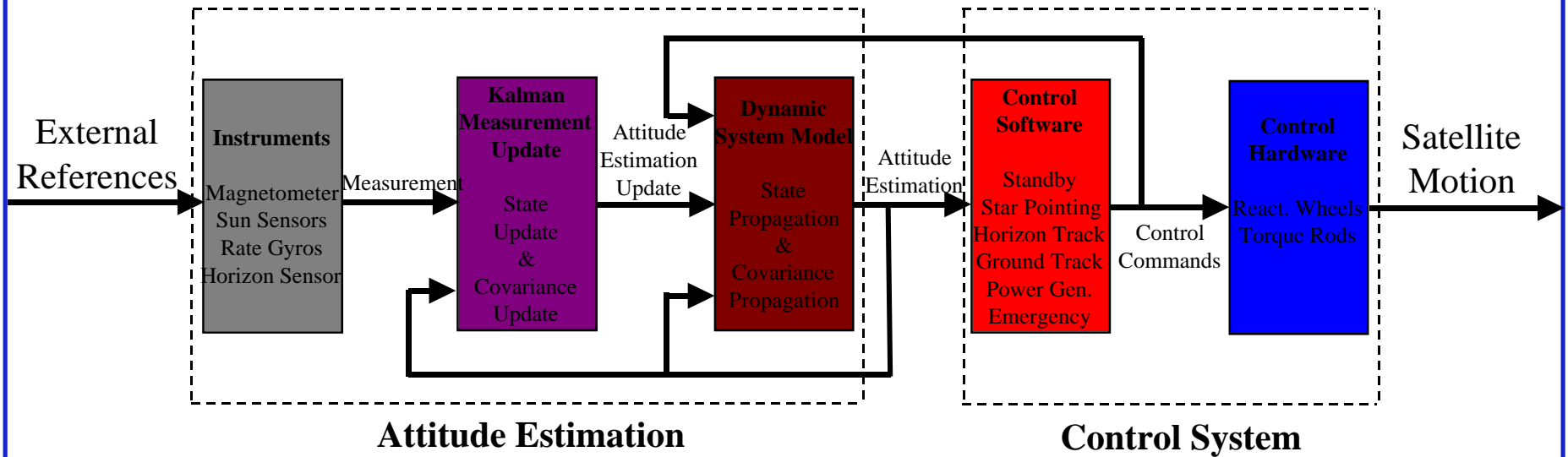
Team Members:

- Matt Angiulo (AME)
- Greg Chatel (AME)
- David Faulkner (AME)
- Marc Geuzebroek (Phys)
- Barry Goeree (AME)
- James Harader (AME)
- Marissa Herron (AME)
- Steve Hoell (Phys)
- Brian Ibbotson (AME)
- Martin Lebl (CSC)
- Adam Mahan (ECE)
- Brian Shucker (Phys/Math)
- Daniel Stone (AME)



Guidance, Navigation, and Controls

Generalized GNC System



Attitude Estimation Sensors

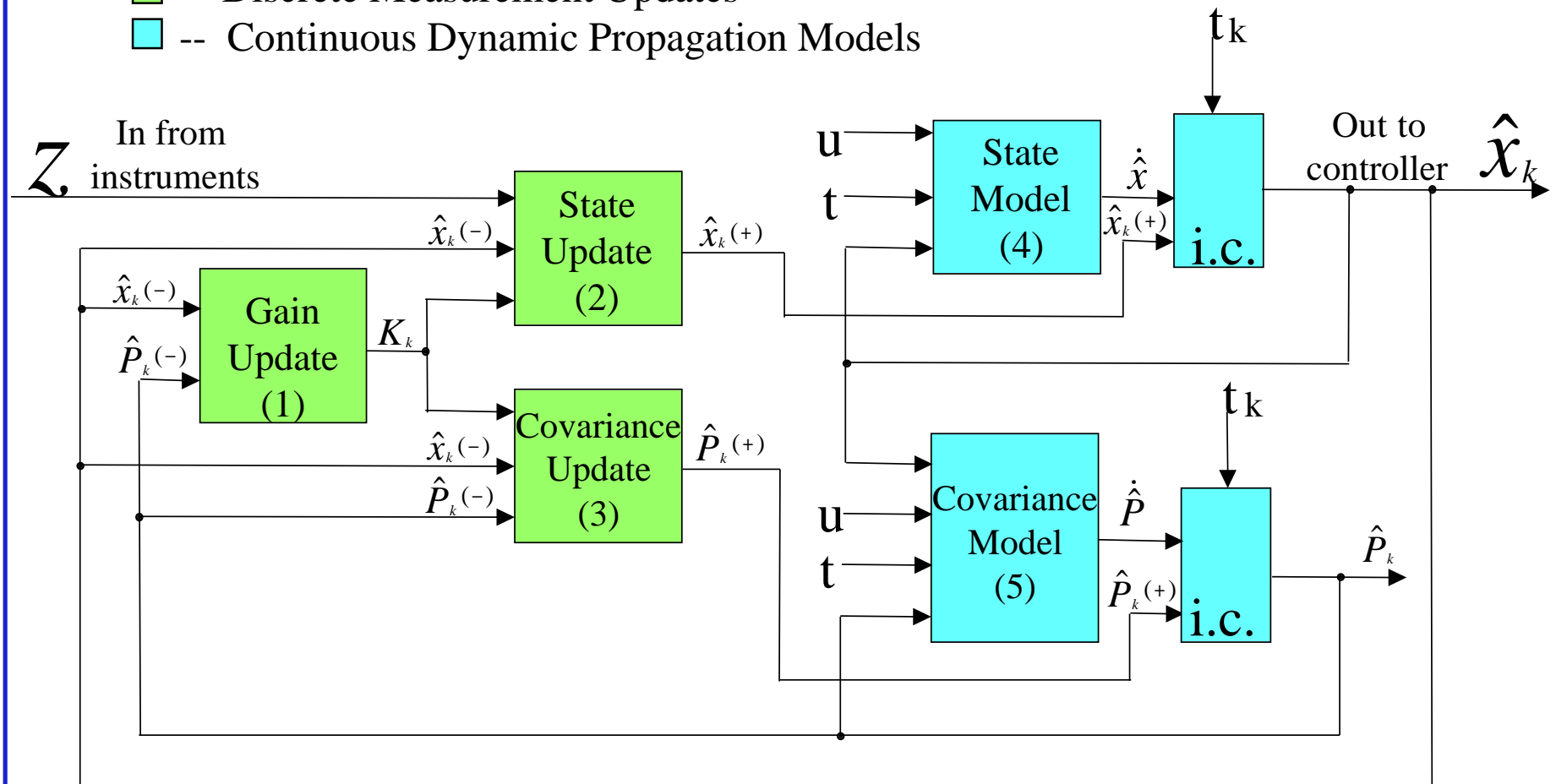
- GPS
- Magnetometer
- Sun Sensor
- Horizon Sensor
- Star Tracker
- Integrating Rate Gyro



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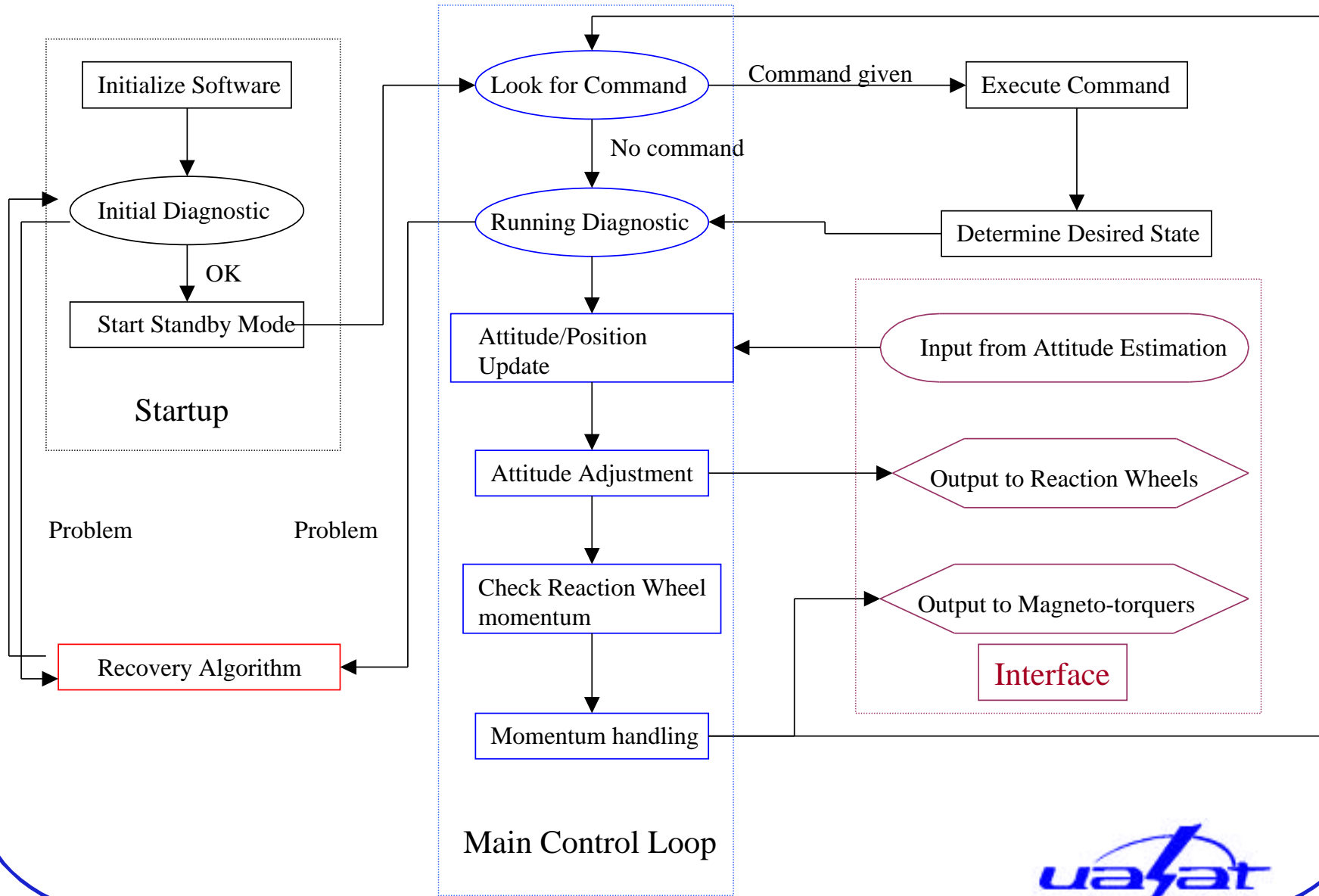
Extended Kalman Filter Block Diagram

- -- Discrete Measurement Updates
- -- Continuous Dynamic Propagation Models



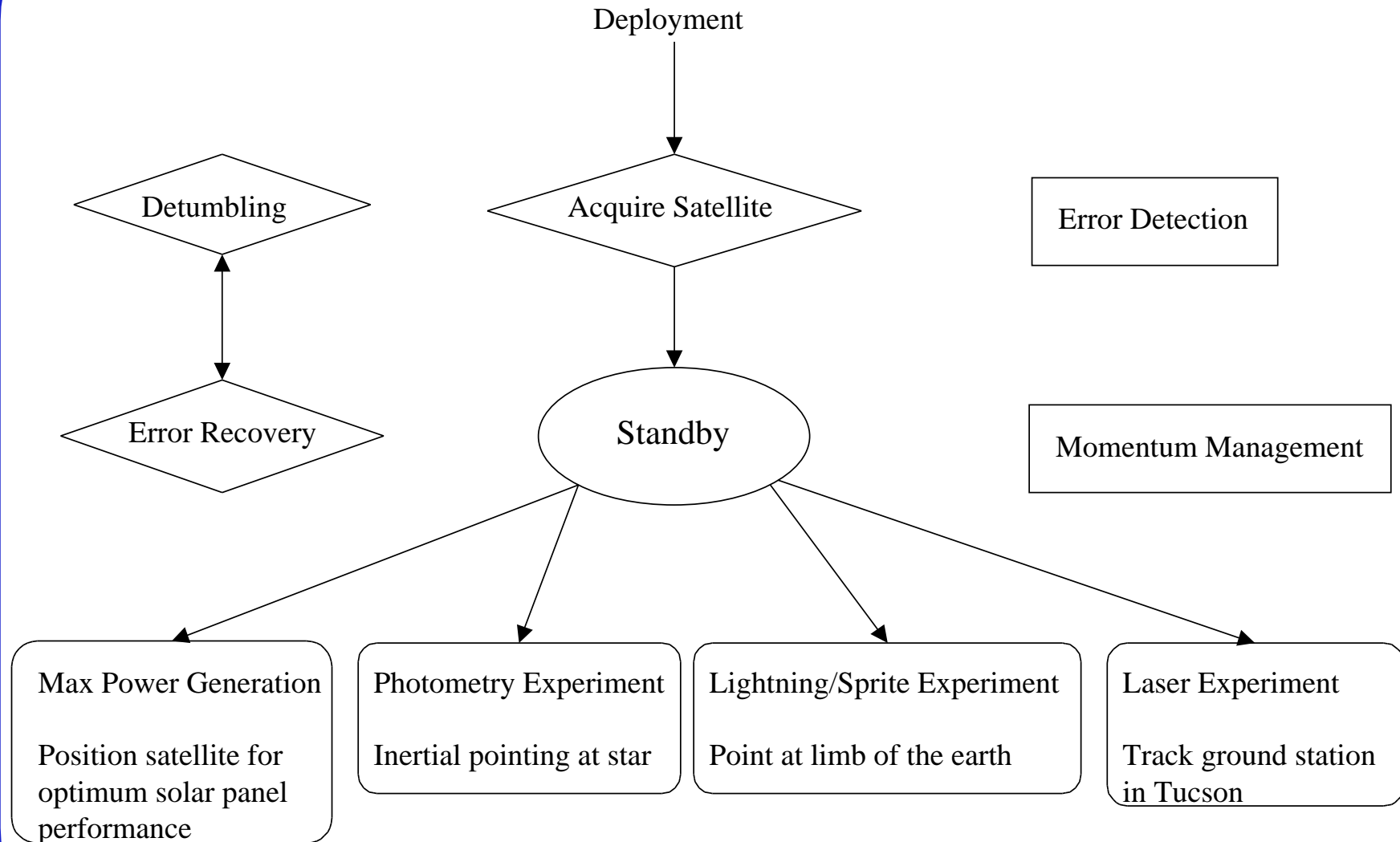
Guidance, Navigation, and Controls

Control Software Overview



Guidance, Navigation, and Controls

Basic Control Modes



Attitude Control Simulation

- What is simulated?
 - Torques acting on satellite determine how attitude changes with time. These equations of motion are integrated in time.
 - This is different than what STK does!
- What are we trying to achieve?
 - Obtain accurate estimates for important design parameters like max torque and momentum storage.
 - Analysis and verification of control and attitude estimation algorithms.



Attitude Control Simulation

- What's included in the simulation?
 - aerodynamic drag torques
 - magnetic field models
 - sun sensor model
 - dynamics of satellite, orbital kinematics
 - control algorithms
 - simple visualization
 - kinematics of ground station tracking



Attitude Control Simulation

- What needs to be done?
 - solar pressure
 - gravity gradient
 - attitude estimation algorithms
 - models of all other sensors (magnetometer, horizon sensor)
 - continue work on control algorithms
 - kinematics of other control modes
 - more realistic visualizations



Attitude Control Devices

- Dynacon Mini Reaction Wheels
 - Size: 80 x 80 x 100 mm
 - Power: 2.5 W ea @ 2000 RPM
 - Optional integrated rate sensor: 1 W
 - Angular Momentum Capacity: 0.3 N-m-s
- Student Designed Torque Rods
 - lost our Space Grant student
 - found a detailed paper on designing torque rods