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Scope of Software Architectures Flight Simulator Case Study

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Flight Simulators Key Characteristics

- ❑ Real-time performance constraints
 - Extremely high fidelity demands
 - Requires distributed computing
 - Must execute at high fixed frame rates
 - Often called *harmonic frequencies*
 - » e.g. often 60Hz, 30Hz; some higher (100Hz)
 - Coordination across simulator components
 - All portions of simulator run at integral multiple of base rate
 - e.g. if base rate = 60Hz, then 30Hz, 15Hz, 12Hz, etc.
 - Every task must complete on time
 - Delays can cause *simulator sickness*

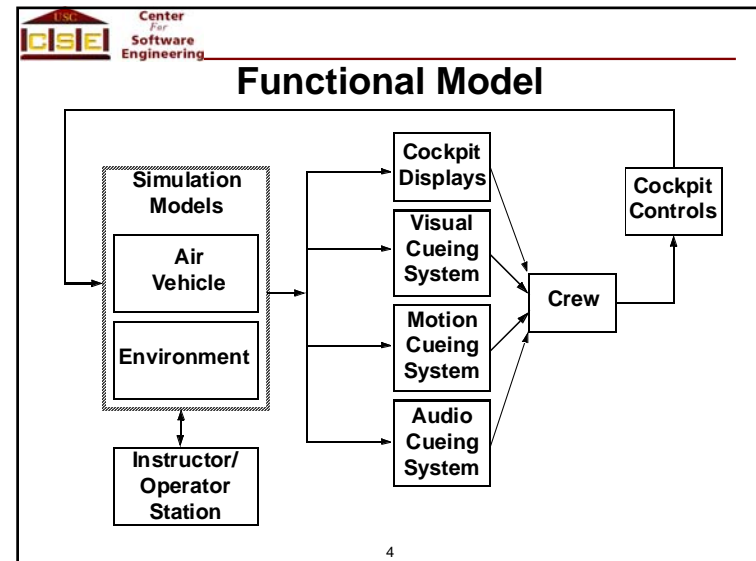
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Flight Simulators Key Characteristics (cont.)

- ❑ Continuous evolution
- ❑ Very large & complex
 - Millions of SLOC
 - Exponential growth over lifetime of simulator
- ❑ Distributed development
 - Portions of work sub-contracted to specialists
 - Long communication paths increase integration complexity
- ❑ Expensive verification & validation
 - Direct by-product of above characteristics
- ❑ Mapping of Simulation SW to HW components unclear
 - Efficiency muddies abstraction
 - Needed because of historical HW limitations

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How Is The Complexity Managed?

- **New style**
 - “Structural Modeling”
 - Based on
 - Object-oriented design to model air vehicle’s
 - Sub-systems
 - Components
 - Real-time scheduling to control execution order
- **Goals of Style**
 - Maintainability
 - Integrability
 - Scalability

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How Is the Complexity Managed? (cont.)

- **Style principles**
 - Pre-defined partitioning of functionality among SW elements
 - Restricted data- & control-flow
 - Data-flow through export areas only
 - Decoupling objects
 - Small number of element types
 - Results in replicated subsystems
 - Objects fully encapsulate their own internal state
 - No side-effects of computations
 - Narrow set of system-wide coordination strategies
 - Employs pre-defined mechanisms for data & control passing
 - Enable component communication & synchronization

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Flight Simulator Architecture In The Structural Modeling Style

- **Five basic computational elements in two classes**
 - Executive (or infrastructure)
 - Periodic sequencer
 - Event handler
 - Synchronizer
 - Application
 - Components
 - Subsystems
- **Each of the five has**
 - Small API
 - Encapsulated state
 - Severely limited external data upon which it relies

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