MODULARITY & COMPOSITION: AUTOMATING SYSTEM SYNTHESIS

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MODULAR COMPONENTS ARE INESCAPABLE

- Component-based systems track robotics research
  - Distributed
  - Prescriptive
  - Manual
  - Messy
INTEGRATION IS UNIVERSAL

• Complex robot design can’t/shouldn’t be done in one-shot
  ○ Or by one person

• Integration provides a descriptive step

• Challenge is structure
PARAMETERIZATION FOR INTEGRATION

• Track component development

• Descriptive

• Manual

• Generating structure in the face of limited resources
Context-Aware System Synthesis

[arXiv:1706.04580 cs.RO]
COMPONENT MODEL

• Tasks & Devices
  ○ Compositional
  ○ Resources

• Modules
  ○ Regularize functionality over components
SYNTHESIS APPROACH
ESCHER OVERVIEW

• Built for the DARPA Robotics Challenge

• Complex Computing Setup
  ○ Optional Field Computing
  ○ Degraded Communications

• Complex Software Design
  • >1.7 million SLOC
  • 3 middleware systems
  • 3 teams, 5 universities
  • 9.120s for synthesis
ESCHER HARDWARE

Manual

Synthesized

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HARDWARE DIFFERENCES
SW DIFFERENCES

Manual

Synthesized