

# Simulation Driven Computational Synthesis

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**Goal:** Synthesis of action selection policy for autonomous operation of unmanned sea surface vehicles (USSV)

**Accomplishments:**

- Developed a new approach for automated policy synthesis for unmanned vehicles operating in adverse continuous environments
- Developed a customized hierarchical behavior-based planning architecture
- Developed an advanced physics based simulation platform for USSVs



Sponsor: Office of Naval Research

Participants: S.K. Gupta, S. Lubard, R. Kavetsky, P. Svec, M. Schwartz, and A. Thakur

**Goal:** Synthesis of drive mechanisms for flapping wing micro air vehicles

**Accomplishments:**

- Developed a simulation based optimization methodology to design an optimal compliant drive mechanism
- Developed in-mold assembly methods to realize novel lightweight multi-material drive mechanisms
- Characterized performance of drive mechanism by conducting flight tests

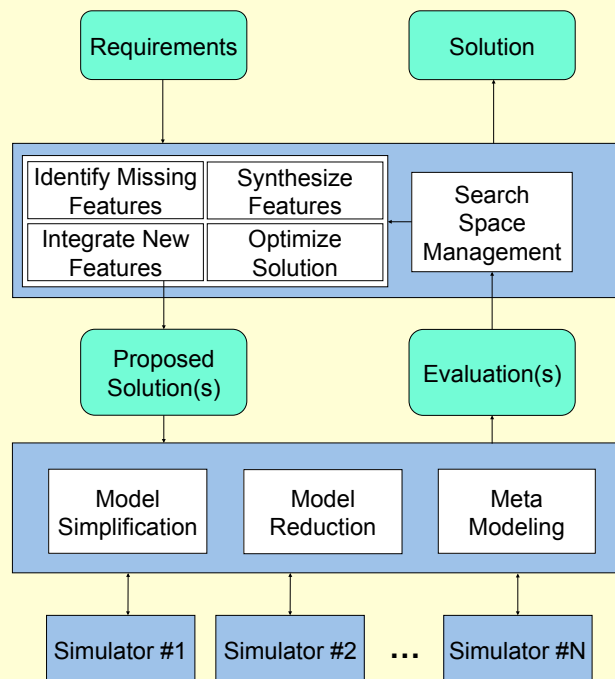


|                    |         |
|--------------------|---------|
| Overall Weight     | 38.0 g  |
| Payload Capability | 33.0 g  |
| Flapping Frequency | 6.1 Hz  |
| Wing Span          | 63.5 cm |

Sponsor: Army Research Office

Participants: S.K. Gupta, A. Ananthanarayanan, W. Bejgerowski, H. Bruck, J. Gerdes, D. Mueller

**Overall Goal:** Develop mathematical and algorithmic foundations for simulation driven computational synthesis and utilize it to solve challenging synthesis problems



## Research Focus

- Physics Based Interactive Simulations
- Robot Structure Synthesis
- Gait Synthesis for Biologically Inspired Robots
- Behavior Synthesis
- Motion / Trajectory Planning
- Programming by Demonstration

**Goal:** Design a planner to automatically transport particles using optical tweezers

**Accomplishments:**

- Developed a comprehensive simulation tool
- Developed a simplified trapping probability model by using Gaussian Radial Basis Functions to represent simulation data compactly
- Developed a path planning algorithm using stochastic dynamic programming



Sponsor: National Science Foundation

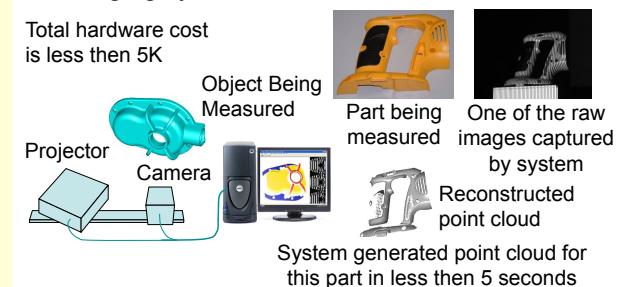
Participants: S.K. Gupta, A. Balijepalli, A.G. Banerjee, S. Chowdhury, T. LeBrun, W. Losert, and T. Peng

**Goal:** Synthesis of adaptive projection patterns for 3D shape measurement

**Accomplishments:**

- Developed comprehensive mathematical models and algorithms for shape reconstruction and system calibration using adaptive patterns
- Developed algorithms that utilize minimum possible number of images
- Developed an inexpensive, accurate, and fast 3D imaging system

Total hardware cost is less than 5K



Sponsor: MIPS and API

Participants: S.K. Gupta and T. Pang