Panel Summary #1

Proposal Number: 1357983

Panel Summary:

SUMMARY OF PROPOSAL
The goal of this collaborative GOALI project is to study new control and design paradigms for dual-stage positioning systems that will enable high-speed, high-precision positioning. Typical systems use temporal pre-filters to distinguish between short-range, high-frequency motions and long-range, low-frequency motions. This approach, however, does not adequately address all of the operational space. For example, the control of short-range, low-frequency motion is not adequately addressed by current approaches. The proposed project would address this by the application of spatial filters.

INTELLECTUAL MERIT
Strengths:
- This presents a novel way for addressing a recognized technical challenge.
- The PIs have prior experience in the area and have proven success with past systems. They are likely to be successful if funded.

Weaknesses:
- There were no major weaknesses identified.

BROADER IMPACT
Strengths:
- Industrial co-PI enhances potential impact
- Wide range of educational activities specified.

Weaknesses:
- None identified.

DATA MANAGEMENT PLAN
The proposed data management plan is sufficient.

SUMMARY RATIONALE FOR PANEL RECOMMENDATION
This is a well-defined problem where the need that the PIs are addressing is clear, and the PIs have a high probability of success. This is a meaningful proposal.

The summary was read by/to the panel and the panel concurred that the summary accurately reflects the panel discussion.

Panel Recommendation: Primary Consideration
Review #1

Proposal Number: 1537983
NSF Program: Dynamics, Control and System Diagnostics (DCSD)
Principal Investigator: Leong, Kam K
Proposal Title: GOALI/Collaborative Research: Precision Control of Nanopositioners
Rating: Very Good

REVIEW:

In the context of the five review elements, please evaluate the strengths and weaknesses of the proposal with respect to intellectual merit.

Overview
The PI proposes to develop dual stage nanopositioning stages where a deficiency of present approaches is overcome.

Proposed work and approach
The PI proposes to realize a dual stage nanopositioner for multiple axis. They have already realized a 1-axis dual stage nanopositioner. In the next objective, the PIs indicate the deficiency of existing dual stage controller design which are temporal frequency based. Here in existing designs a small magnitude signal with small temporal frequency content is passed handled by the low bandwidth large positioning system which typically has lower resolution. The inverse condition of a large magnitude signal with high temporal frequency will get routed to the small range high bandwidth and high resolution positioning system. The PIs provide an elegant spatial filter based idea which they have tested on the one dimensional nanopositioning system. GOALI proposal will build the multi-axis nanopositioning system in collaboration with Molecular Vista.

Critique: The PIs have identified a deficiency in existing positioning system and have provided a convincing strategy to overcome the deficiency. The proposal has a convincing and strong experimental component.

In the context of the five review elements, please evaluate the strengths and weaknesses of the proposal with respect to broader impacts.

Broader Impact: The broader impacts are adequate.

Please evaluate the strengths and weaknesses of the proposal with respect to any additional solicitation-specific review criteria, if applicable

Summary Statement
The proposal has identified a key deficiency in nanopositioning and has provided a rational solution strategy. The PIs back their work with solid and substantive experimental platform.
Review #2

Proposal Number: 1537983
NSF Program: Dynamics, Control and System Diagnostics (DCSD)
Principal Investigator: Loang, Kam K
Proposal Title: GOALI/Collaborative Research: Precision Control of Nanopositioners
Rating: Very Good

REVIEW:

In the context of the five review elements, please evaluate the strengths and weaknesses of the proposal with respect to intellectual merit.

PI's seek to improve the control of nanopositioners to achieve both short/long range and slow/fast temporal control. This is a GOALI proposal in collaboration with industry. To improve positioners is a need in ARM (atomic force microscopy) imaging and in micro/nano fabrication.

The authors have recognized a need in this area, and they are clearly expert in this space. The intellectual merit is the mathematical and experimental foundations for meeting this technological need. It is clear the team can achieve its goals. There are no major weaknesses. This is a solid proposal.

In the context of the five review elements, please evaluate the strengths and weaknesses of the proposal with respect to broader impacts.

Broader impact includes educational outreach: course development and experimental platforms for courses, senior capstone design, and K12 outreach.

Please evaluate the strengths and weaknesses of the proposal with respect to any additional solicitation-specific review criteria, if applicable

N/A

Summary Statement

This is a solid proposal. No major weaknesses.
Review #3

Proposal Number: 1537983
NSF Program: Dynamics, Control and System Diagnostics (DCSD)
Principal Investigator: Leong, Kam K
Proposal Title: GOALI/Collaborative Research: Precision Control of Nanopositioners
Rating: Very Good

REVIEW:

In the context of the five review elements, please evaluate the strengths and weaknesses of the proposal with respect to intellectual merit.

This GOALI project's goal is to study new design and control paradigms for dual-stage nanopositioners that consider both spatial and temporal constraints.

+ The long-range stage is bandwidth-limited, and the fast short-range stage is range-limited. Mitigating these shortcomings is a worthwhile task to investigate.
+ The PI has been making significant contributions in this research field and is one of the experts to make this project successful.
+ The collaboration plan is well thought-out. The industry partner has an ongoing NSF SBIR project and will be able to provide practical insights to the project.

- It is unclear how the new control strategies and feedback filtering processes will affect the dual-stage design. This reviewer would like to see more details to support the novelty of the proposed approach. There is only a top-level discussion provided in Section 4.1.
- What are the new design principles and how will the design iteration be performed? What will be the gain in the speed and range with the application of the proposed approach?

In the context of the five review elements, please evaluate the strengths and weaknesses of the proposal with respect to broader impacts.

The PIs are dedicated to K-12 education with good track records and will involve under-represented minority students through Villanova's VESTED program and University of Utah's Center for Student Cultural Diversity. They plan to create a low-cost nanopositioning system with 3D printing to be employed in their System Dynamics, Control, and Mechatronics Courses. They will seek for additional funding (including an NSF REU supplement) to support undergraduate research.

Please evaluate the strengths and weaknesses of the proposal with respect to any additional solicitation-specific review criteria, if applicable.

Summary Statement

This is a well-planned proposal with worthy objectives.