**BUDGET JUSTIFICATION**

1. **Senior Personnel: ($87, 144 Cumulative Total)**

**PI Liujun Li** will commit 260 hours or 1.5 mos. of summary salary per year to this project. Base salary is ($85,004/academic year). PI will serve as the principal contract manager and be responsible for supervising one FTE postdoc research associate to conduct the drones-enabled active sensing system development, numerical simulation and experiment validation of the drone swarm formation control and its synonization of active thermal imaging for subsurface defetect detection; potential inspection pracitoner evaluation; manage contract budget; publishing research results; and provide progress and final reports to NSF. Dr. Li will also oversee analyzing and compiling data, constructing a database for the project, keeping timelines, and coordinating the overall research progress. Total salary request is ($14,592).

Post Doc Research Associate will commit 100% of time to this project. Base salary is $48,000. Post doc will setup bridge inspection scenarios and conduct drone swarm control simulation; acquire and construct open-source drone swarm system platform for field flight testing; prototype a directed solar energy concentrator system based on a two-stage solar Fresnel condensing lens and pinpoint mechanism; conduct ctive thermal imaging field protocol experimental design and optimization; develop visual relative navigation algorithm development and field testing; perform active thermal imaging experiment for subsurface defects detection. Total salary request is $48,000.

1. **Other Personnel: ($4,144 Cumulative Total)**

**Undergraduate student (1, TBD, supervised by Li)** will be hired for 2 months in the summer with a hourly rate of $12.5/hour budgeted to ensure that project makes steady progression towards its objectives. Total salary will be $12.5 \* 40 \* 4 \* 2=$4,000.

1. **Fringe Benefits**

Fringe benefits are 30.1% for faculty, 42% for staff and 3.6% for temporary help students. \

1. **Equipment**

Not requested.

1. **Travel: ($3,550 Cumulative Total)**

Funds are requested for the following travel for the PD meeting and to present research findings to the broader research communities.

**Project Stakeholder Meeting ($1,000).** Funds are requested for PD Dr. Li to travel to Department of Transportation State officer and bridge inspection industrial stakeholder to discuss bridge inspection field protocols and obtain the permission of UAV swarm field experimentation ($1,000). The cost of travel is for the purpose of meeting the program manager to discuss the plan and progress ($1,000).

**Professional Conference ($2,550).** Funds are requested for PD Dr. Li to attend one professional conference (such as the 2023 ROSCon annual meeting) in Years 2. Conference locations have not been confirmed so we estimate a per conference cost of ($2,550), which includes: airfare ($1290), lodging ($200/night \* 4 nights = $800), ground transportation ($65 \* 2 = $130), and per diem ($55/day \* 6 days = $330).

1. **Participant Support Costs**

Not requested.

1. **Other Direct Costs ($3,934 Cumulative Total)**
2. Materials and Supplies ($3,934 Cumulative Total)

Funds are requested for the following project-specific materials and supplies necessary for the proposed wheat crop plant cultivation and greenhouse management:

* $1,000 for two-stage solar Fresnel condensing lens acquisition and pinpoint mechanism construction.
* $2,934 in for lead-follower drone swarm system integration with GPS and Vision system as well as active thermal imaging system, miscellaneous lab supplies cost (electrical cables and wires, lab safety, labware, disposables, etc.)

1. Consultant/Service Contracts  
   Not requested.
2. ADP/Computer Services  
   Not requested.
3. Equipment or Facility Rental Fees  
   Not requested.
4. Alterations and Renovations  
   Not requested.
5. Other Direct Cost

Not requested.

**Total Direct Costs ($98, 773 Cumulative Total)**

**H. Total Indirect Costs ($49, 387 Cumulative Total)**   
$49,387 is requested for indirect costs. This is calculated at 50% on the Modified Total Direct Costs (MTDC) which includes Senior Personnel, Other Personnel, Fringe Benefits, Materials and Supplies, and Travel; less Other (Other = capital equipment and tuition/fees for the graduate student). These rates were negotiated with the US Department of Health and Human Services on July 8th, 2021.

1. **Total Direct and Indirect Costs: $148,159**