Report to the NASA EPSCoR Program

Kentucky NASA EPSCoR Research Infrastructure Development Program

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Table of Contents

Research Infrastructure Development Program Plan

Goals, Objectives, and Priorities of the Kentucky NASA EPSCoR Program

Goals: The Kentucky NASA EPSCoR Research Infrastructure Development Program is proposed for the mutual long-term benefit of NASA and Kentucky, through

- Development of Kentucky research infrastructure capacity with direct links to NASA
- Establishment of collaborative research in areas of strategic importance to NASA

Priorities: The Kentucky NASA EPSCoR Program supports NASA's programs and Vision for Exploration priorities with expanded research capacity. Kentucky benefits through the development of an academic research enterprise directed toward long-term, self-sustaining, nationally competitive capability in aerospace applications. The program will enhance interrelationships between Kentucky and NASA and among participating institutions in the State, and will contribute to the State's economic viability.

Objectives: Principal objectives of the Research Infrastructure Development program are:

- To increase the number of investigators in Kentucky who connect and collaborate with NASA researchers in areas of current and long-term importance to NASA's missions
- To develop expanded collaborations within Kentucky for larger multi-investigator projects in support of NASA mission research and development for present and future needs

The program is based on determining areas of overlap between NASA's strategic interests and Kentucky's research capabilities. Within this context, the program specifically targets Kentucky investigators who are less-experienced and who will:

- Determine how they can contribute to NASA's strategic needs through consultation and planning with NASA researchers
- Establish a research project in direct collaboration with researchers at NASA Centers or in NASA Mission Directorates, addressing research or development of importance to the NASA mission
- Work toward achieving a sustainable research effort, based on future competitive funding from NASA or other federal sources
- Develop a plan for expanding the research in NASA's interests to a multi-investigator team effort that is competitive for further development under future NASA EPSCoR Research Area funding opportunities*

*As NASA announces opportunities for multi-investigator Research Area awards, the Research Infrastructure Development Program will serve as a ready structure to call for proposals from Kentucky researchers, to review and evaluate the proposals with existing advisory personnel, and to submit selected proposals to NASA.

We seek the best of these less-experienced Kentucky investigators on the basis of potential to achieve sustainable, competitive, expandable research in areas that contribute to and benefit NASA's strategic interests. Kentucky will benefit through the development of aerospace research capability that is sustainable through competitive federal funding.

Project Elements

Research Infrastructure Development Grants to Develop Research Collaborations with NASA Centers and Mission Directorates

The primary purpose of the Kentucky NASA EPSCoR Research Infrastructure Development Program is to establish mutually beneficial, collaborative linkages between increased numbers of Kentucky investigators and NASA researchers, as a basis for building capacity for sustainable aerospace-related research in Kentucky. Investigators at all Kentucky institutions of higher education will be eligible for support, based on competitive proposals.

Awards will be specifically targeted to involve investigators in research collaborations with NASA laboratories, addressing needs as identified by NASA collaborators in support of NASA's strategic needs and interests. More-experienced investigators may propose with a investigator as funded Co-I, for the purposes of

- Mentoring the investigators in connecting and collaborating with NASA, and
- Coordinating the design of a larger multi-investigator project to propose for the State in future NASA EPSCoR Research Area opportunities.

In January prior to each program year, the Kentucky NASA EPSCoR Subcommittee/Technical Advisory Committee will solicit proposals for support of research infrastructure development projects by Kentucky less-experienced investigators in collaboration with NASA researchers. The NASA EPSCoR Center Office will distribute the RFP statewide to inform potential researchers of the opportunity. Recipients of the Research Infrastructure Development grants will be determined on the basis of competitive proposals solicited from all colleges and universities in Kentucky. The solicitation is equal opportunity and will seek involvement of greater numbers of women and members of underrepresented groups. The Kentucky NASA EPSCoR Subcommittee/ Technical Advisory Committee will select awardees at a meeting held in May in conjunction with the Annual Kentucky EPSCoR Conference.

Criteria in the RFP for Research Infrastructure Development awards will include:

1. Indication by the NASA collaborator(s) of the importance of the project to NASA and their plan for direct collaboration in the project
2. Formative discussion of a plan for expanding the research in NASA's interests to a multi-investigator team effort that is competitive for further development under future NASA EPSCoR Research Area funding opportunities
3. Statement of a plan for achieving a sustainable research effort, based on future competitive funding from NASA or other federal sources

Required responsibilities of the PI will include:

1. Reporting on the development and growth of the collaboration with the researcher(s) at the NASA Center(s) or Mission Directorates(s)
2. Submission of a follow-on proposal for non-EPSCoR NASA or other federal funding to sustain the project, as well as publications and presentations of results of the project
3. Submission for review and possible selection for forwarding of a multi-investigator Research Area proposal to the national NASA EPSCoR Program

Funded research projects will begin in August and continue through the ensuing year. Progress reports are due from the investigators the following April, for evaluation and incorporation into the annual program reports to NASA and to the Kentucky EPSCoR Committee. The infrastructure development activities will recur on an annual cycle for the duration of the Kentucky NASA EPSCoR Research Infrastructure Development Program Cooperative Agreement. Funding recipients will be eligible for renewal, in competition with new applicants, and the development of longer-term projects will be encouraged.

Encouragement of Inclusion of Students

Experience with student support under previous NASA EPSCoR cooperative agreements underscores the importance of student involvement in NASA EPSCoR Research Infrastructure Development projects. Student involvement in learning scientific practice by participating in scientific research and connecting with NASA research efforts provides an important contribution to the development of human resources in support of the Kentucky strategic priority to "ensure that Kentucky education systems prepare highly skilled, knowledgeable graduates (including teachers) with the necessary mathematics and science capabilities for successfully maneuvering in the 21st Century knowledge economy."

Researchers proposing infrastructure-building collaborative projects with NASA will be encouraged to include students in their research proposals. Students may work in the research project at their home institution or at the collaborating NASA Center, or a combination of both, as needed to fulfill the scientific objectives of the project. As part of their experience in learning scientific practice, participating students must be provided with mentoring, interaction with the NASA collaborator(s), and opportunities to prepare and deliver presentations of results, such as publications and/or presentations at scientific meetings and conferences.

Student research contributions will be featured in the presentations at the Annual EPSCoR Conference. Researchers will be encouraged to ensure that the students interact with the collaborating NASA Center(s) and NASA researcher(s). Students receiving significant funding under any of these programs will be longitudinally tracked to document their successes through attaining their first employment.

Coordination with Space Grant and NASA Student Opportunities

Researchers will also be encouraged to recruit other prospective student researchers by working with them to propose mentored component research in the annual statewide competition for graduate research fellowships and undergraduate research scholarships offered by the Kentucky Space Grant Consortium. Researchers in Kentucky Space Grant Consortium projects will be encouraged to propose NASA EPSCoR Research Infrastructure Development projects to develop larger multi-investigator collaborative projects with NASA. Researchers in all programs will be

asked to encourage students to apply for NASA opportunities such as the NASA Academies, the NASA Graduate Student Research Program (GSRP) and Undergraduate Research Program (USRP), and for student research experiences and internships at the NASA Centers.

Overall coordination of the Kentucky NASA EPSCoR Program and the Kentucky Space Grant Consortium is facilitated by shared administrative structure and management. The Director of the Kentucky NASA EPSCoR Program is also the Director of the Kentucky Space Grant Consortium. From the office, communications and announcements for both programs are coordinated, and participants of each program are informed of all opportunities available in both programs.

Annual State Meeting for NASA EPSCoR and Space Grant

An aerospace forum will be conducted each year, normally in May, as part of the Kentucky Annual Statewide EPSCoR Conference. The component aerospace forum will provide opportunities for NASA ESPCoR researchers to present results from their projects, and to interact with other-agency EPSCoR researchers, Space Grant researchers. and students who also present in the forum. The forum is attended by members of the NASA EPSCoR Technical Advisory Committee and External Advisory Panel, and by members of the Kentucky Space Grant Consortium Committee. The EPSCoR Conference and included aerospace forum together provide an important opportunity for these members to review the progress and results of projects in both programs, and to interact with the overall Kentucky EPSCoR Program to see the full context of EPSCoR in Kentucky.

Alignment with Kentucky Priorities and Agendas

Kentucky's needs and priorities in science and technology have been determined and presented in the state's adopted plan: *The Kentucky Science and Technology Strategy*. The following discussion is focused on items in the plan describing Kentucky's goals, needs, and strategies that are addressed most directly by NASA EPSCoR.

Goal: The Kentucky Science and Technology Strategy states that the overarching goal is:

- To create an innovation-driven, entrepreneurial economy that makes Kentucky a leader in the development of knowledge and its applications to people, firms and products.

Needs: Conditions cited by the Strategy as necessary for success include:

- Increased federal and industry R&D funds
- Expanded university support and leadership role

Priorities: Two key strategies are identified as priorities for development in Kentucky:

- Technological Infrastructure: Build the technological infrastructure (i.e., Kentucky know-how) that is essential to ensuring a competitive Kentucky economy.
- People: Ensure that Kentucky education systems prepare highly skilled, knowledgeable graduates (including teachers) with the necessary mathematics and science capabilities for successfully maneuvering in the 21st Century knowledge economy.

Strengths: *The Kentucky Science and Technology Strategy* acknowledges that:

> Kentucky appears to have the potential to build world class knowledge and companies in several areas including electronic commerce (including printers, printing, logistics and software); energy and materials science; life sciences (including medical sciences pharmaceuticals, agricultural biotechnology); logistics and distribution (including software

and engineering services); nutrition and food technologies; and vehicle parts and components (including plastics, metals, parts, components, materials and devices).

Kentucky's Priority Focus Areas:

- Biosciences
- Environmental and Energy Technologies
- Human Health and Development
- Information Technology and Communications
- Materials Science and Advanced Manufacturing

Fundamental Role of EPSCoR: *The Kentucky Science and Technology Strategy* expresses Kentucky's need for development of technological infrastructure and human resources, and recognizes that EPSCoR programs have been and will continue to be vital forces in achieving this development.

Agenda of the Statewide Kentucky EPSCoR Program:

- Strengthening the capability of researchers and institutions in the Commonwealth
- Improving the quality of Research and Development
- Developing the ability of researchers and institutions to compete for non-EPSCoR Federal, State and private sector R&D funding
- Aiding undergraduate education and the private sector through technology transfer and technological improvements

The Kentucky NASA EPSCoR Program is aligned with and directly supports Kentucky's agenda and priorities as outlined in the *Kentucky Science and Technology Strategy* and as discussed above. The Kentucky NASA EPSCoR Program operates as a component of the statewide multi-agency Kentucky EPSCoR Program and fully supports its agenda and goals, working in the context of aerospace-related research that supports NASA's needs and mission priorities as well.

Alignment with NASA Research or Technology Development Priorities

National and Agency Priorities

NASA's overarching priorities derive from the President's 2004 directive: *A Renewed Spirit of Discovery: The President's Vision for U. S. Space Exploration*, by which the Agency and Nation are committed to:

- A journey of exploring the solar system and beyond
- Returning to the Moon in the next decade
- Venturing further into the solar system
- Ultimately sending humans to Mars and beyond.

The *Vision for Space Exploration* is translated into strategic goals for NASA for the period 2006 through 2016 in the *2006 NASA Strategic Plan*. The two documents together define the strategic needs and interests of NASA for the present and future, and both will be cited in our Requests for Proposals as primary references for beginning proposal planning and seeking NASA researchers with whom to collaborate in solving problems of interest to NASA. Current NASA contacts at the Mission Directorates and University Affairs Officers at the Centers will serve as the Kentucky researchers' points of contact for developing projects of strategic interest to NASA

and collaborations with specific NASA researchers in conducting the projects.

As NASA provides the lead for the Nation in the implementation of the exploration vision, university researchers and other participants provide amplified expertise and research capacity, working with NASA researchers to achieve the national vision. All Research Infrastructure Development projects will be required to show that the research directly supports a need recognized by NASA for support of its mission. Selection will be strongly based on the participation of the NASA researcher(s) and their certification of the importance of the research to NASA's priorities.

NASA Education Priorities

The Kentucky NASA EPSCoR Program supports the NASA Education Strategic Coordination Framework in contributing to the development of the highly-educated and well-prepared workforce that has been and continues to be critical to the success of the Agency's mission. Specifically, through the involvement of students in mentored research connected with NASA, the Kentucky NASA EPSCoR Program supports the following goals of the NASA 2006 Education Strategy and Framework:

- **Strengthen NASA and the Nation's future workforce**—NASA will identify and develop the critical skills and capabilities needed to ensure achievement of the Vision for Space Exploration. To help meet this demand, NASA will continue contributing to the development of the Nation's science, technology, engineering, and mathematics (STEM) workforce of the future through a diverse portfolio of education initiatives that target America's students at all levels, especially those in traditionally underserved and underrepresented communities.
- **Attract and retain students in STEM disciplines**—NASA will focus on engaging and retaining students in STEM education programs to encourage their pursuit of educational disciplines and careers critical to NASA's future engineering, scientific, and technical missions.

The Program supports the following Outcomes and Objectives in the NASA Education portfolio:

- **Outcome 1**: Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goal through a portfolio of investments.
  - **Objective 1.1** – Faculty and Research Support: Provide NASA competency-building education and research opportunities for faculty, researchers, and post-doctoral fellows.
  - **Objective 1.5** – Targeted Institution Research and Academic Infrastructure: Improve the ability of targeted institutions to compete for NASA research and development work.
- **Outcome 2**: Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty.

The Kentucky NASA EPSCoR research projects, including opportunities for mentored student research, support both Outcomes 1 and 2. Objective 1.1 is the basis for the Kentucky NASA EPSCoR Program. Objective 1.5 is addressed through encouraging investigators to include faculty at targeted institutions in their multi-investigator proposals, providing opportunities for start-up involvement at institutions that may not have the basic supportive infrastructure and tradition of promoting faculty research.

Project Evaluation

Policies for Interaction Among the TAC, External Panel, and Director

The principal interactions among the TAC, External Panel, and Project Director will occur at the annual Kentucky NASA EPSCoR Subcommittee meeting, chaired by the (non-voting) Project Director. At the meeting, the Subcommittee/TAC will receive the External Panel's reviews of proposals submitted in the statewide proposal competition and will discuss the proposals based on reviews and evaluation by the TAC membership. The process will include roundtable discussions with the External Panel members to incorporate their advice concerning proposals and program planning issues. The TAC will make formal decisions regarding the selection of proposals and program planning issues. Between meetings, the Project Director will work via mail and email communications with the TAC and External Panel to determine schedules, to develop and distribute requests for proposals (in January), and to plan and evaluate the program.

Schedule for Regular Meetings of the Technical Advisory Committee

The Technical Advisory Committee and the External Review and Advisory Panel will meet annually in May, in conjunction with the Annual Kentucky EPSCoR Conference. Both groups will interact with the jurisdiction researchers in a presentation session. With advice from the Advisory Panel, the TAC and Program Director will evaluate the investigators' progress and performance.

Project Evaluation

The Kentucky NASA EPSCoR Research Infrastructure Development Program will be evaluated formatively each year, with a summative evaluation at the end of the third year, evaluating overall program performance. The evaluation will be performed by the Technical Advisory Committee and program management, who will include the results in the annual program reports. Metrics used for the evaluation process include the following:

Key Metrics Used for Program Evaluation

Quantifiable Performance Metrics:

The quantitative metrics include tangible expectations for the research projects, with particular emphasis on submission of follow-on proposals by the investigators.

- ♦ Articles published in or submitted to refereed journals
- ♦ Presentations and abstracts at professional meetings
- ♦ Follow-on grant proposal submissions and awards
- ♦ Invention disclosures, patent applications, patent awards, technology transfer

Qualitative Evaluation Criteria:

Expectations for developing effective collaborative relationships with NASA will be evaluated based on the following qualitative information:

- ♦ Extent of interaction, collaborations, and results developed with NASA
- ♦ Progress in development of relationship with NASA researcher(s)
- ♦ Quality of follow-on proposal for NASA Research Area multi-investigator proposal

Information on which to base the evaluations will be acquired from annual progress reports provided by the principal investigators. These reports will be required to include performance data in the form of both the quantifiable metrics and qualitative criteria described above.

In addition to reporting project progress and measurable outcomes, the principal investigators will report on the details of their collaboration with the NASA researcher(s) and progress in further developing the relationship with those researchers for evaluation of the qualitative metrics given below.

In the annual conference, TAC meeting, and site visits, program management and the Technical Advisory Committee will be advised by the External Panel and NASA participants to aid in evaluating research performance and in planning for program enhancement.

Students receiving significant funding under this program will be longitudinally tracked to document their successes through attaining their first employment. The mentoring PI will be required to follow and report on student progress annually, during and following the term of the project. The close relationship developed between the mentor and the student researcher is the basis for continuing response from students after they leave the program.

Timeline for Each Project Year (Funding year beginning in May)

January (prior)	Issue RFP for Preparation Projects
April (prior)	Preparation Proposals Due
May (prior)	Selection of Projects for Award
August (begin funded year)	Funded Projects Begin
April	PI Reports Due
May	Presentations at EPSCoR Conference
May	Evaluation of Projects
May	Program Report to NASA
July	Program Report to Kentucky EPSCoR
July	End of Projects Funded for the Year

Report

The Program supports the following Outcomes and Objectives in the NASA Education portfolio:

- **Outcome 1**: Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goal through a portfolio of investments.
  - **Objective 1.1** – Faculty and Research Support: Provide NASA competency-building education and research opportunities for faculty, researchers, and post-doctoral fellows.
  - **Objective 1.5** – Targeted Institution Research and Academic Infrastructure: Improve the ability of targeted institutions to compete for NASA research and development work.

Outcome 2: Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty.

Kentucky NASA EPSCoR Objectives: Principal objectives of the Research Infrastructure Development program are:

- To increase the number of investigators in Kentucky who connect and collaborate with NASA researchers in areas of current and long-term importance to NASA's missions
- To develop expanded collaborations within Kentucky for larger multi-investigator projects in support of NASA mission research and development for present and future needs

With the available funding we have been able to increase the number of investigators in Kentucky who connect and collaborate with NASA researchers in areas of current and long-term importance to NASA's missions. Five projects have been funded in the period involving six less-experienced investigators. With current funding we have identified five more projects for approval for the coming year with two new investigators and three renewals.

Annual Progress Report

Improvements in Jurisdiction Research and Development Infrastructure

The Kentucky NASA EPSCoR Program has contributed to improving Kentucky's research and development infrastructure at two levels. First, the NASA-EPSCoR-funded research projects facilitate the development of researchers' capabilities and connections for future competitive funding for research and development. Data obtained during this funding cycle for Haluk Karaca and Michael Seigler's Research Infrastructure Development project formed the basis for the follow-up Research Area proposal submitted to Kentucky NASA EPSCoR.

MARIT (Multiple Air Robotics Indoor Testbed): One subaward PI has successfully received a *$53,450* worth of equipment donation, a 6 Camera Vicon Motion Capture System, from the Vicon Motion Systems Inc in *November 2008* as part of the KY NASA EPSCoR grant. The PI is currently establishing ***MARIT (Multiple Air Robotics Indoor Testbed)*** facility at UofL (University of Louisville) using this donation and Draganflyers as shown in Figures 1 through 3. This testbed will be one of the very few indoor air robotics testbed in the nation, similar to the one recently built at MIT. ***It will play a key role the future multi investigator, nationwide NASA-EPSCoR and other non NASA-EPSCoR proposals.***

The testbed is being developed to handle ***multiple air robots*** rather than a single one since ***NASA's future air robotics missions will include multiple air robots*** *(probably one mother ship and multiple small air robots).* Draganflyers will be used rather than lighter than air (LTA) air robots since Dr. Elfes's research group at JPL aims to develop systems using a large LTA and small quadrocopter like Draganflyers for multiple air robot teams. ***This will be the subject that the PI plans to develop for the nationwide NASA EPSCoR proposal in collaboration with scientists from NASA-JPL (Jet Propulsion Laboratory) and Caltech.***

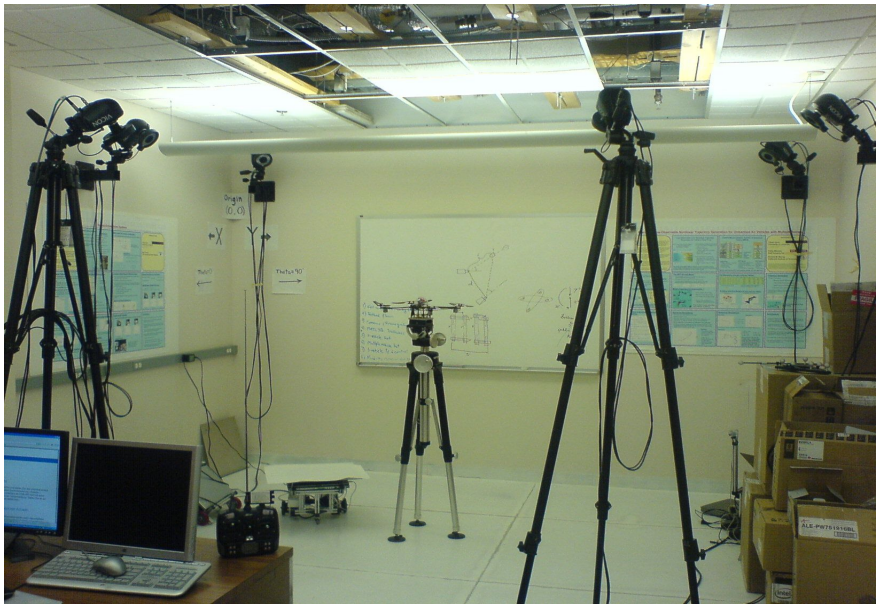
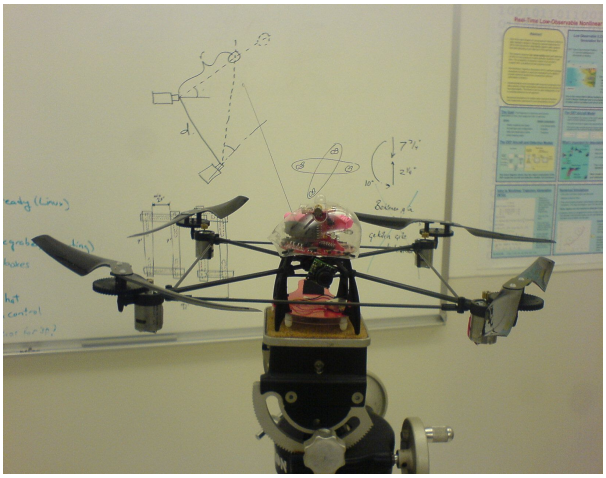


Figure 1. ***MARIT (Multiple Air Robotics Indoor Testbed)*** is currently being established at Dr. Inanc's research lab at UofL. Six Vicon MX+ cameras (donation from Vicon Inc.) and a quadrocopter Draganflyer are shown. There will be two Draganflyers in the testbed.



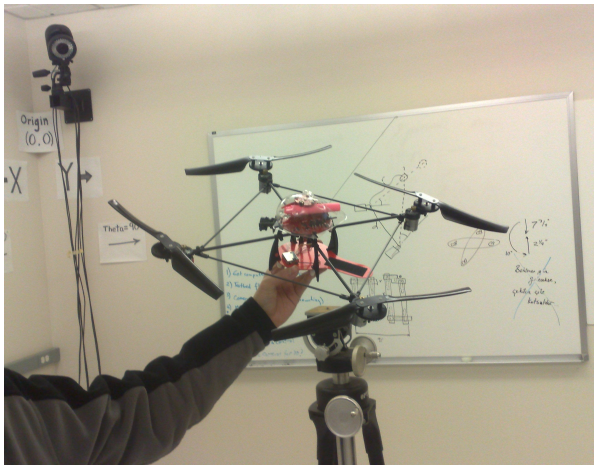


Figure 2 & 3. A quadrocopter Draganflyer which can be operated safely in indoors as well as in outdoors is shown.

The Mechanics of Materials Laboratory has been established at the University of Kentucky where high temperature shape memory and material property characterization study takes place. Mechanical property characterization using the MTS Landmark system, phase transformation temperatures determination by DSC, dynamic mechanical property characterization by DMA can be conducted in the laboratory. Moreover, experience on how to conduct nanoindentation, microhardness and profilometer experiments on the shape memory properties are gathered.

Murray State University has acquired interface hardware for a sensor data acquisition device, which will be used for testing and optimization of sensing layers prior to their adaptation to a microfluidic environment.

On another level, the NASA EPSCoR Program is a component of the Kentucky statewide multi-agency EPSCoR effort, which coordinates and amplifies the reach and effect of EPSCoR in

developing R&D infrastructure in Kentucky. The Kentucky Statewide EPSCoR organization is planning a major upgrade of Kentucky's Strategic Plan for Science and Technology in the form of a Cyberinfrastructure Strategic Plan component for the Commonwealth. The initial plan led to the establishment of Kentucky state government's New Economy Initiative. It also led to the formation of the Kentucky Science and Engineering Foundation (KSEF) as an agency for the state (analogous to the NSF) in funding for R&D efforts that contribute to further development of R&D infrastructure and economic development in Kentucky. The KSEF is an initiative of the Kentucky Science and Technology Corp., which receives funds from the Kentucky Council on Postsecondary Education as part of the Kentucky Innovation Act. The Kentucky Science and Technology Corporation is conducting strategic planning for Kentucky Space launch initiatives. The new governor has provided support through the Kentucky Department of Military Affairs for the associated Near Space balloon launch initiatives.

Extent to Which Collaborations with Jurisdiction Agencies, Industry, Research and Academic Institutions, and with NASA Have Been Developed

In the Research Infrastructure Development Program, all projects are required to be a collaborative effort with NASA personnel, based on a project area of interest to NASA. Consequently, the projects involve collaborations with NASA, including Ames Research Center, Jet Propulsion Laboratory, Johnson Space Center, and Langley Research Center. The collaboration with Ames has developed to the point that Kentucky maintains an office on the campus of the NASA Ames Research Center.

John Hines of NASA Ames is collaborating with a group on a Research Infrastructure Development project in which Dan Johnson is a member. They are now collaborating on a Kentucky Space Grant Consortium grant in support of a Space Grant Research Infrastructure project in support of research specifically to involve students, and student visits to NASA Ames are planned.

Tamer Inanc co-organized "*The Titan Mission Workshop"*, at JPL-Caltech, Pasadena, CA, May 22, 2008. He has five publications in collaboration with the NASA-JPL and Caltech researchers. Cindy Harnett's work spurred a collaboration with Eastern Kentucky University on an NSF research supplement for micro-chemical collectors, which was awarded Spring 2008. Haluk Karaca and Michael Seigler have established a very fruitful and strong collaboration with the NASA-Glenn Center. NASA-Glenn provides the HTSMA samples to conduct shape memory characterization. Research findings have started to reach to the publishing level where two presentation abstracts are submitted for international conferences. There are plans to extend the established collaboration with Dr. Noebe at NASA-Glenn to new alloy systems.

Aly Farag continues to collaborate with Dr. Robert Forbes of the University of Louisville, Geosciences program, Dr. Demetrio P. Zourarakis of the Commonwealth Office of Technology Division of Geographic Information, and Mr. Cam Metcalf of the Kentucky Pollution Center on the work in remote sensing to study urban development, agriculture, landfills, and environmental pollution control. These collaborators have been an excellent source of data. There is also a collaboration with Dr. Haluk Cetin of Murray State University Mid-America Remote Sensing Center (MARC) on basic research with remote sensing data classification.

NASA Collaborators Dr. Arthur T. Bradley of Langley Research Center and Dr. Richard Boyle/ Dr. Xander Twombly, Ph.D. of the BioVIS Technology Center of NASA Ames Research Center continue to advise how best to effectively work toward a large proposal to NASA as funding becomes available in the future. They have repeatedly stated that they are excited about forging the relationship to the next level when NASA funding becomes available.

Achieving the goals of the Kentucky NASA EPSCoR Program requires a high degree of coordination among all of the involved and interrelated constituencies: NASA EPSCoR researchers, NASA collaborators, NASA Center and Directorate personnel, NASA Headquarters program management, Kentucky NASA EPSCoR program management, member institutions and financial offices, institutional offices of research administration and avenues for infrastructure proposal solicitation throughout Kentucky, grant monitoring and performance evaluation, the Statewide Kentucky EPSCoR Committee, the Statewide Kentucky EPSCoR Director, the NASA EPSCoR Subcommittee/Technical Advisory Committee (TAC), an External Review and Advisory Panel, the Kentucky Space Grant Consortium, other agency EPSCoR programs in Kentucky, the Kentucky Council on Postsecondary Education, the Governor's Office (state science policy), and the Kentucky General Assembly (legislature) as the funding source for state matching funds.

Evidence of How EPSCoR Activities Have Furthered Jurisdiction Priorities

Kentucky's priorities, as outlined in the *Kentucky Science and Technology Strategy,* include:

Technological Infrastructure: Build the technological infrastructure (i.e., Kentucky know-how) that is essential to ensuring a competitive Kentucky economy.

- **People:** Ensure that Kentucky education systems prepare highly skilled, knowledgeable graduates (including teachers) with the necessary mathematics and science capabilities for successfully maneuvering in the 21st Century knowledge economy.

Through its research projects, the Kentucky NASA EPSCoR Program contributes directly to the development of Kentucky's technological infrastructure, including faculty and students who are prepared for further contributions to research and development in the Commonwealth. Students participating in EPSCoR research projects gain training in scientific research as a basis for future careers in the technological workforce.

Kentucky has identified some specific areas of emphasis for development within the Commonwealth. Kentucky NASA EPSCoR Research Infrastructure Development projects have directly contributed to development in four of these areas of emphasis, as detailed below:

Kentucky Area of Emphasis	NASA EPSCoR Projects
Materials Science and Advanced Manufacturing	1
Environmental and Energy Technologies	0
Human Health and Development	1
Information Technologies and Communications	2
Biosciences	2

Discussion of Interaction Between and Cooperation with Jurisdiction Space Grant Program

The Kentucky NASA EPSCoR Program works in tandem with the Kentucky Space Grant Consortium, which provides support through: administrative coordination; fellowships and scholarships for participating students; "seed" funding to incubate new space-related research efforts; communication and networking on statewide, NASA-wide, and national scales; and the

development of a "pipeline" of Kentucky students interested in space-related studies and careers. The KSGC and Kentucky NASA EPSCoR programs are jointly administered with a shared Director at Western Kentucky University in Bowling Green. The governing committees of the two organizations function separately and independently, although they share several members in common. The structure helps maintain a mutual awareness between the programs that is beneficial in coordinating their activities synergistically.

Through experience with the NASA EPSCoR and NASA Space Grant Programs, the Kentucky NASA Program has well-established working relationships in which the Project Directors, NASA EPSCoR Subcommittee/TAC, and External Review and Advisory Panel team. This relationship works well to develop research infrastructure, monitor and evaluate progress, advise and aid researchers in programmatic and financial matters, report to funding agencies, interact with NASA personnel, help establish connections and collaborations, interact with the statewide Kentucky EPSCoR Committee and organization, and facilitate day-to-day operation and periodic reporting for the program.

All NASA EPSCoR programs meet at the annual Kentucky EPSCoR meeting where ideas are shared through oral and poster presentations. The day-long event encourages interactions among all researchers, including those participating in the Kentucky Space Grant Program. NASA EPSCoR and Space Grant researchers give their oral presentations at the annual Kentucky Space Grant Consortium Aerospace Forum held as part of the EPSCoR meeting.

Haluk Karaca is working with Space Grant Faculty advisor Dr. Suzanne Smith on how to contribute to the Space Grant by helping on one of the project components in wing design and deployment, airframe and tail.

Of particular note is the way in which the usage of the Space Grant Fellowship and Scholarship Program is enhancing the NASA EPSCoR projects with six students funded through Space Grant.