UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899-

March 11, 2012

MEMORANDUM FOR Howard Harary
Deputy Director, Manufacturing
Engineering Laboratory

From: Al Wavering
Chief, Intelligent Systems Division
Engineering Laboratory

Subject: Recommendation to fund grant from Georgia Tech Research Corporation entitled "*Kitting for Manufacturing Applications*"

In response to a solicitation in the Federal Register through the Measurement Science and Engineering Research Grants Program (Docket Number: 2012-MSE-01), the Intelligent Systems Division of the Engineering Laboratory has received a grant proposal from Georgia Tech Research Corporation entitled "*Kitting for Manufacturing Applications*". This grant proposal addresses our need for common knowledge representations and models for automating kitting of manufacturing processes for more efficient manufacturing.

A panel of three technical experts within the division evaluated the grant proposal. Their attached reviews had an average score of 92.6/100. The approach described appears to address all the relevant technical and safety issues involved in the development of this knowledge model. The principal investigator (PI) has excellent technical credentials and is suitably qualified to perform the work described in the proposal.

Therefore, I recommend that we fully fund the work for the requested amount ($99,829). The Intelligent Systems Division has sufficient funds to cover the costs in our project cost center (735-2006-000).

The reviewers and scores for the proposal were:

	Score
Craig Schlenoff, Mechanical Engineer, Intelligent Systems Division	95/100
Tom Kramer, Mechanical Engineer, Intelligent Systems Division	93/100
Michael Shneier, Group Leader, Intelligent Systems Division	90/100
Average	**92.6/100**

Comments from the review panel are summarized as follows:

Technical Quality: The proposer appears to have very detailed knowledge and critical experience in developing knowledge representation and models for automating kitting of manufacturing processes.

NIST

Impact: The proposed approach appears to be technically sound and of great value to this effort. If successful, not only will it help to make assembly and kitting more efficient and help to allow just-in-time manufacturing.

Staff Capability: The principal investigator is an experienced, world-renowned researcher in the area of industrial automation.

Budget Match: The budget seems appropriate for the level of work in the proposal.

Narrative Recommendation: All reviewers recommended funding this work.

Attached, please find a copy of the proposal and the score sheets from each reviewer.

UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899-

Date: March 12, 2012

Memorandum for NIST Grants Officer

FROM: Albert Wavering
Chief, Division 735
Selecting Official

SUBJECT: Selection Recommendation under FFO 2012-NIST-MSE-01 for proposal/application reviewed from Georgia Tech Research Corporation dated January 12, 2012

Certification of Review and Selection Process:
In accordance with the procedures set forth in the subject FFO, an individual competition was conducted for the attached proposal reviewed on 15-02-2012. I hereby certify that the process as stated here and in the "Review and Selection Process" section of the FFO was followed.

All proposals received in response to the FFO for the Engineering Laboratory Grants and Cooperative Agreements Program are reviewed as received on a rolling basis to determine whether or not they are eligible, complete, and responsive to the FFO and are compatible and relevant to the objectives of the Engineering Laboratory Grants and Cooperative Research Grant Program, as described in the Program Description (Section I.3 of the FFO). Proposals determined to be ineligible, incomplete, and/or non-responsive based on the FFO may be eliminated from further review. Additionally, if it is determined that sufficient funding is not available to consider proposals in the technical area of the proposal, the proposal will not be reviewed for technical merit, and the proposer will be promptly notified of the unavailability of funds for their proposal. The Engineering Laboratory Grants and Cooperative Research Program will post a notice on its Web site when funds are exhausted for the fiscal year.

At least three (3) independent, objective individuals knowledgeable about the particular scientific area described in the proposal will conduct a technical review of each proposal, based on the evaluation criteria (Section V.1.c. of the FFO). If non-federal reviewers are used, the reviewers may discuss the proposals with each other, but scores will be determined on an individual basis, not as a consensus.

The Selecting Official, who is the EL Director, EL Deputy Director, or appropriate EL Division Chief will make final proposal selections, taking into consideration the results of the reviewers' evaluations, relevance to the objectives described in the EL Grant Program Description (Section I.3. of the FFO), and the availability of funds. The selection of proposals by the Selecting Official is final.

NIST reserves the right to negotiate the budget costs with the proposers that have been selected to receive awards, which may include requesting that the proposer remove certain costs. Additionally, NIST may request that the proposer modify objectives or work plans and provide supplemental information required by the agency prior to award. NIST also reserves the right to reject a proposal where information is uncovered that raises a reasonable doubt as to the responsibility of the proposer. NIST may select part, some, all, or none of the proposals. The final approval of selected proposals and issuance of awards will be by the NIST Grants Officer. The award decisions of the Grants Officer are final.

Evaluation Criteria:
The evaluation criteria used by the independent reviewers was:

(1) Technical Quality of the Research. The rationality, innovation and imagination of the proposal, and the fit to NIST's in-house EL programs. (0 – 35 points)

NIST

(2) Potential Impact of the Results. The potential impact and the likelihood of the technical application of the results. (0 – 25 points)

(3) Staff and Institution Capability to Perform the Work. The quality of the facilities and experience of the staff to assess the likelihood of achieving the objective of the proposal. (0 – 20 points)

(4) Match of Budget to Proposed Work. Assessment of the budget against the proposed work to ascertain the reasonableness of the request. (0 – 20 points)

Individual Reviews and Instructions:
Attached hereto are copies of the individual reviews and any instructions that were provided to the reviewers.

List of Previously Approved Proposals:
The priority score for this proposal is consistent with the priority scoring levels for proposals this program has previously recommended for funding as noted below.

(a) Southwest Research Institute (SWRI), *"Development of Standards Test Methods to Evaluate Performance of Emergency Response Robots," $107,606.00-funded. Scores 100, 99, and 93.*

(b) Texas Engineering Extension Service (TEEX), *"Robotics Exercise to Conduct Research into Performance Measures Applied to Realistic Urban Search and Rescue Training Scenarios," $46,565.00-funded. Scores 100, 99, and 95.*

(c) University of Maryland, Baltimore County, *" Information Streaming of the NIST Disaster and Failure Events Database for Extreme Events," $81,619.00-1st year funded. Scores 98, 95 and 95.*

Technical Evaluation/Applicant Selection:
In selecting applications, I took into consideration the proposers detailed knowledge and critical experience in developing knowledge representation and models for automation kitting of manufacturing processes; the potential to improve efficiency for just-in-time manufacturing; and the principal investigators world-renowned reputation in industrial automation research. I hereby recommend funding the reviewed proposal for Georgia Tech Research Corporation, *Kitting for Manufacturing Applications*, with an average score of 92.6, and an estimated cost of $99,829.

Cost Evaluation:
The proposed budget has been reviewed for relevancy and realism to the program described in the proposal. All proposal costs, [except those noted below, if any] are found to be fair and reasonable.

Level of Federal Involvement [Substantial or Non-Substantial]: Non-Substantial

Statement of Benefits:

1. Benefit to NIST: This research will further the current research in automated manufacturing.

2. Benefit to the Recipient: The Principal Investigator will be able to work collaboratively with NIST to further his research in automated manufacturing.

3. Benefit to the General Public: The benefit to the general public is the advancement of just-in-time manufacturing that will help make the US manufacturers more competitive to foreign companies.

Federal Program Officer:

The Federal Program Officer (FPO) Stephen Balakirsky, who is responsible for monitoring the technical and scientific progress of the award, and has been assigned in the Grants Management Information System (GMIS), has the requisite knowledge and skills to monitor the award and is a direct hire employee of the U.S. Government.

Questions related to this selection can be addressed to me at extension 3461.

Engineering Laboratory
Unsolicited Grant Proposal Technical Review (Proposal #2012-735-2002)

Date: 1/23/2012 **Reviewer Name/Signature:** W. Stanek

Proposal Title: Kitting for Manufacturing Applications

Principal Investigator(s) and Institution: Georgia Tech Research Corporation, PI: Henrik Christensen; CO: Serelia Woods

Technical Quality of the research (0-35):	**Your Score:** 30
Potential Impact of the results (0-25):	**Your Score:** 20
Staff and Institution Capability to do the work (0-20):	**Your Score:** 20
Match of Budget to proposed work (0-20):	**Your Score:** 20
TOTAL SCORE (0-100):	90

Rating Justifications:

Technical Quality:
The grant addresses a problem of direct relevance to the ARRA program. The suggested approach matches very well with the work being conducted at NIST

Impact:
The proposed work will speed up progress on the planning and modeling effort. The ultimate impact will be a broader capability to create and share kitting plans in industrial applications

Staff Capability:
The staff at Georgia Tech are highly qualified and well suited to carrying out the proposed work

Budget Match: The budget seems appropriate for the level of work in the proposal.

Engineering Laboratory
Unsolicited Grant Proposal Technical Review (Proposal #2012-735-2002)

Date: 1/23/2012 **Reviewer Name/Signature:** Thomas R. Kramer

Proposal Title: Kitting for Manufacturing Applications

Principal Investigator(s) and Institution: Georgia Tech Research Corporation, PI: Henrik Christensen; CO: Serelia Woods

Technical Quality of the research (0-35):	**Your Score:** 33
Potential Impact of the results (0-25):	**Your Score:** 22
Staff and Institution Capability to do the work (0-20):	**Your Score:** 19
Match of Budget to proposed work (0-20):	**Your Score:** 19
	TOTAL SCORE (0-100): 93

Rating Justifications:

Technical Quality: This work will complement the work planned in ISD's IPMAS program. The survey of kitting methods use in industry will be particularly valuable.

Impact: Methods of automating kitting are needed, particularly where production run size does not justify the costs of fixed automation. Flexible automation that is applicable to a wide range of industries will have a large impact. The proposed work will help in the development of it.

Staff Capability: The principal investigator is an experienced, world-reknowned researcher in the area of industrial automation.

Budget Match: The personnel assignments are appropriate for the proposed work and the compensation is appropriate for the personnel.

Engineering Laboratory
Unsolicited Grant Proposal Technical Review (Proposal #2012-735-2002)

Date: 1/23/2012 **Reviewer Name/Signature:** Craig Schlenoff

Proposal Title: Kitting for Manufacturing Applications

Principal Investigator(s) and Institution: Georgia Tech Research Corporation, PI: Henrik Christensen; CO: Serelia Woods

Technical Quality of the research (0-35):	**Your Score:** 34
Potential Impact of the results (0-25):	**Your Score:** 24
Staff and Institution Capability to do the work (0-20):	**Your Score:** 20
Match of Budget to proposed work (0-20):	**Your Score:** 17
	TOTAL SCORE (0-100): 95

Rating Justifications:
Technical Quality: (see attached)

Impact:

Staff Capability:

Budget Match:

Technical Quality: The proposers seem to have a very strong handle on the assembly and kitting domains within manufacturing. They also are very well tied in to important businesses in this area, including Boeing, Lockheed Martin, and General Motors. Their proposal is sound and they appear to understand the value of a common knowledge representation for kitting processes and also understand what it will take to develop and implement one. (Score: 34)

Impact: If successful, this work will have a significant impact. Not only will it help to make assembly and kitting more efficient and help to allow for just-in-time manufacturing, it will also help to make US manufacturers more competitive to foreign companies. Also, Georgia Tech's strong relationship with various US manufacturers will help to ensure that the work that is performed is relevant and beneficial to them. (Score: 24)

Staff Capability: The staff assigned to this project seems exemplary. Henrik Christianson is world renown in this area. He has been working in this general area for many years and has a history of very strong results. (Score: 20)

Match of budget to proposed work: This work covers one graduate student, various trips to NIST, participation in two workshops, various hardware such as computers, and overhead fees. The cost of approx.. $100K seems right for the output that is proposed and the people that will be involved. (Score: 17)

Total Score: 95

Hunton, Christopher

From: Serelia Woods [Serelia.Woods@osp.gatech.edu]
Sent: Tuesday, January 17, 2012 11:31 AM
To: christopher.hunton@nist.gov
Cc: Christensen, Henrik I; joi@cc.gatech.edu
Subject: FW: URGENT - INFORMATION NEEDED ASAP re: NIST GRANT APPLICATION

Importance: High

Hi Chris,

The information you need is provided below.

Best,

Serelia D. Woods
Contracting Officer
Office of Sponsored Programs
Georgia Institute of Technology
505 10th Street, N.W.
Atlanta, GA 30332-0420
Phone: 404-385-0866
Fax: 404-894-5945
Email: serelia.woods@osp.gatech.edu
Web: www.osp.gatech.edu

From: Christensen, Henrik I. [mailto:hic@cc.gatech.edu]
Sent: Tuesday, January 17, 2012 10:28 AM
To: Serelia Woods
Cc: Adams, Joi; Bennett, Carla F.
Subject: Re: URGENT - INFORMATION NEEDED ASAP re: NIST GRANT APPLICATION
Importance: High

We did respond to the email Dec 22, but we can certainly do that again.

The proposal is going to the Engineering Laboratory Grant and the NIST contact / PM is

Dr. Stephen Balakirsky
Intelligent Systems Division → 735
National Institute of Standards and Technology
100 Bureau Drive, M/S 8230
Gaithersburg, MD 20899-8230
Tel: (301)975-4791 Fax: (301)990-9688
email: stephen@nist.gov

Sincerely

Henrik

OMB Number: 4040-0004
Expiration Date: 01/31/2009

Application for Federal Assistance SF-424

Version 02

* 1. Type of Submission:	* 2. Type of Application:	* If Revision, select appropriate letter(s):
☐ Preapplication	☒ New	
☒ Application	☐ Continuation	* Other (Specify)
☐ Changed/Corrected Application	☐ Revision	

* 3. Date Received:	4. Applicant Identifier:
01/12/2012	

5a. Federal Entity Identifier:	* 5b. Federal Award Identifier:

State Use Only:

6. Date Received by State:	7. State Application Identifier:

8. APPLICANT INFORMATION:

* a. Legal Name: Georgia Tech Research Corporation

* b. Employer/Taxpayer Identification Number (EIN/TIN):	* c. Organizational DUNS:
580603146	097394084

d. Address:

* Street1:	Office of Sponsored Programs
Street2:	505 Tenth Street
* City:	Atlanta
County:	
* State:	GA: Georgia
Province:	
* Country:	USA: UNITED STATES
* Zip / Postal Code:	30332-0420

e. Organizational Unit:

Department Name:	Division Name:
Sponsored Programs (OSP)	

f. Name and contact information of person to be contacted on matters involving this application:

Prefix:		* First Name:	Serelia
Middle Name:			
* Last Name:	Woods		
Suffix:			

Title: Contracting Officer

Organizational Affiliation:
Georgia Tech Research Corporation

* Telephone Number:	404-385-0866	Fax Number:	404-894-5945

* Email: serelia.woods@osp.gatech.edu

OMB Number: 4040-0004
Expiration Date: 01/31/2009

Application for Federal Assistance SF-424

Version 02

9. Type of Applicant 1: Select Applicant Type:

H: Public/State Controlled Institution of Higher Education

Type of Applicant 2: Select Applicant Type:

Type of Applicant 3: Select Applicant Type:

* Other (specify):

*** 10. Name of Federal Agency:**

National Institute of Standards and Technology

11. Catalog of Federal Domestic Assistance Number:

11.609

CFDA Title:

Measurement and Engineering Research and Standards

*** 12. Funding Opportunity Number:**

2012-NIST-MSE-01

* Title:

Measurement Science and Engineering (MSE) Research Grant Programs

13. Competition Identification Number:

2012-NIST-MSE-01

Title:

14. Areas Affected by Project (Cities, Counties, States, etc.):

USA

*** 15. Descriptive Title of Applicant's Project:**

Kitting for Manufacturing Applications

Attach supporting documents as specified in agency instructions.

Add Attachments | Delete Attachments | View Attachments

OMB Number: 4040-0004
Expiration Date: 01/31/2009

Application for Federal Assistance SF-424

Version 02

16. Congressional Districts Of:

* a. Applicant: GA-005
* b. Program/Project: GA-005

Attach an additional list of Program/Project Congressional Districts if needed.

Add Attachment | Delete Attachment | View Attachment

17. Proposed Project:

* a. Start Date: 07/15/2012
* b. End Date: 06/14/2014

18. Estimated Funding ($):

* a. Federal	99,829.00
* b. Applicant	0.00
* c. State	0.00
* d. Local	0.00
* e. Other	0.00
* f. Program Income	0.00
* g. TOTAL	99,829.00

*** 19. Is Application Subject to Review By State Under Executive Order 12372 Process?**

☐ a. This application was made available to the State under the Executive Order 12372 Process for review on

☐ b. Program is subject to E.O. 12372 but has not been selected by the State for review.

☒ c. Program is not covered by E.O. 12372.

*** 20. Is the Applicant Delinquent On Any Federal Debt? (If "Yes", provide explanation.)**

☐ Yes ☒ No

21. *By signing this application, I certify (1) to the statements contained in the list of certifications and (2) that the statements herein are true, complete and accurate to the best of my knowledge. I also provide the required assurances** and agree to comply with any resulting terms if I accept an award. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties. (U.S. Code, Title 218, Section 1001)**

☒ ** I AGREE

** The list of certifications and assurances, or an internet site where you may obtain this list, is contained in the announcement or agency specific instructions.

Authorized Representative:

Prefix:	
* First Name:	Serelia
Middle Name:	
* Last Name:	Woods
Suffix:	
* Title:	Contracting Officer
* Telephone Number:	404-385-0866
Fax Number:	404-894-5945
* Email:	serelia.woods@osp.gatech.edu
* Signature of Authorized Representative:	Serelia Woods
* Date Signed:	01/12/2012

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Standard Form 424 (Revised 10/2005)
Prescribed by OMB Circular A-102

Application for Federal Assistance SF-424

Version 02

*** Applicant Federal Debt Delinquency Explanation**

The following field should contain an explanation if the Applicant organization is delinquent on any Federal Debt. Maximum number of characters that can be entered is 4,000. Try and avoid extra spaces and carriage returns to maximize the availability of space.

BUDGET INFORMATION - Non-Construction Programs

OMB Number: 4040-0006
Expiration Date: 06/30/2014

SECTION A - BUDGET SUMMARY

Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. 2012-NIST-MSE-01	11.609	$	$	$ 49,648.00	$ 0.00	$ 49,648.00
2. Year 2				50,181.00	0.00	50,181.00
3.						
4.						
5. Totals		$	$	$ 99,829.00	$	$ 99,829.00

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Prescribed by OMB (Circular A -102) Page 1

Tracking Number:GRANT11034453

SECTION B - BUDGET CATEGORIES

6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY (1)	(2)	(3)	(4)	Total (5)
	2012-NIST-MSE-01	Year 2			
a. Personnel	$ 21,312.00	$ 22,378.00	$	$	$ 43,690.00
b. Fringe Benefits	320.00	335.00			655.00
c. Travel	1,600.00	800.00			2,400.00
d. Equipment					
e. Supplies	2,775.00	2,322.00			5,097.00
f. Contractual					
g. Construction					
h. Other	9,936.00	10,731.00			20,667.00
i. Total Direct Charges (sum of 6a-6h)	35,943.00	36,566.00			$ 72,509.00
j. Indirect Charges	13,705.00	13,615.00			$ 27,320.00
k. TOTALS (sum of 6i and 6j)	$ 49,648.00	$ 50,181.00	$	$	$ 99,829.00
7. Program Income	$	$	$	$	$

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Prescribed by OMB (Circular A -102) Page 1A

SECTION C - NON-FEDERAL RESOURCES

(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e)TOTALS
8.	$	$	$	$
9.				
10.				
11.				
12. TOTAL (sum of lines 8-11)	$	$	$	$

SECTION D - FORECASTED CASH NEEDS

	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	$ 99,829.00	$ 24,958.00	$ 24,957.00	$ 24,957.00	$ 24,957.00
14. Non-Federal	$				
15. TOTAL (sum of lines 13 and 14)	$ 99,829.00	$ 24,958.00	$ 24,957.00	$ 24,957.00	$ 24,957.00

SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT

(a) Grant Program	FUTURE FUNDING PERIODS (YEARS) (b)First	(c) Second	(d) Third	(e) Fourth
16. 2012-NIST-MSE-01	$ 50,181.00	$	$	$
17.				
18.				
19.				
20. TOTAL (sum of lines 16 - 19)	$ 50,181.00	$	$	$

SECTION F - OTHER BUDGET INFORMATION

21. Direct Charges: 72508

22. Indirect Charges: 27320

23. Remarks:

OMB Number: 4040-0007
Expiration Date: 06/30/2014

ASSURANCES - NON-CONSTRUCTION PROGRAMS

PLEASE DO NOT RETURN YOUR COMPLETED FORM TO THE OFFICE OF MANAGEMENT AND BUDGET. SEND IT TO THE ADDRESS PROVIDED BY THE SPONSORING AGENCY.

NOTE: Certain of these assurances may not be applicable to your project or program. If you have questions, please contact the awarding agency. Further, certain Federal awarding agencies may require applicants to certify to additional assurances. If such is the case, you will be notified.

As the duly authorized representative of the applicant, I certify that the applicant:

1. Has the legal authority to apply for Federal assistance and the institutional, managerial and financial capability (including funds sufficient to pay the non-Federal share of project cost) to ensure proper planning, management and completion of the project described in this application.

2. Will give the awarding agency, the Comptroller General of the United States and, if appropriate, the State, through any authorized representative, access to and the right to examine all records, books, papers, or documents related to the award; and will establish a proper accounting system in accordance with generally accepted accounting standards or agency directives.

3. Will establish safeguards to prohibit employees from using their positions for a purpose that constitutes or presents the appearance of personal or organizational conflict of interest, or personal gain.

4. Will initiate and complete the work within the applicable time frame after receipt of approval of the awarding agency.

5. Will comply with the Intergovernmental Personnel Act of 1970 (42 U.S.C. §§4728-4763) relating to prescribed standards for merit systems for programs funded under one of the 19 statutes or regulations specified in Appendix A of OPM's Standards for a Merit System of Personnel Administration (5 C.F.R. 900, Subpart F).

6. Will comply with all Federal statutes relating to nondiscrimination. These include but are not limited to: (a) Title VI of the Civil Rights Act of 1964 (P.L. 88-352) which prohibits discrimination on the basis of race, color or national origin; (b) Title IX of the Education Amendments of 1972, as amended (20 U.S.C.§§1681-1683, and 1685-1686), which prohibits discrimination on the basis of sex; (c) Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. §794), which prohibits discrimination on the basis of handicaps; (d) the Age Discrimination Act of 1975, as amended (42 U.S.C. §§6101-6107), which prohibits discrimination on the basis of age; (e) the Drug Abuse Office and Treatment Act of 1972 (P.L. 92-255), as amended, relating to nondiscrimination on the basis of drug abuse; (f) the Comprehensive Alcohol Abuse and Alcoholism Prevention, Treatment and Rehabilitation Act of 1970 (P.L. 91-616), as amended, relating to nondiscrimination on the basis of alcohol abuse or alcoholism; (g) §§523 and 527 of the Public Health Service Act of 1912 (42 U.S.C. §§290 dd-3 and 290 ee- 3), as amended, relating to confidentiality of alcohol and drug abuse patient records; (h) Title VIII of the Civil Rights Act of 1968 (42 U.S.C. §§3601 et seq.), as amended, relating to nondiscrimination in the sale, rental or financing of housing; (i) any other nondiscrimination provisions in the specific statute(s) under which application for Federal assistance is being made; and, (j) the requirements of any other nondiscrimination statute(s) which may apply to the application.

7. Will comply, or has already complied, with the requirements of Titles II and III of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (P.L. 91-646) which provide for fair and equitable treatment of persons displaced or whose property is acquired as a result of Federal or federally-assisted programs. These requirements apply to all interests in real property acquired for project purposes regardless of Federal participation in purchases.

8. Will comply, as applicable, with provisions of the Hatch Act (5 U.S.C. §§1501-1508 and 7324-7328) which limit the political activities of employees whose principal employment activities are funded in whole or in part with Federal funds.

9. Will comply, as applicable, with the provisions of the Davis-Bacon Act (40 U.S.C. §§276a to 276a-7), the Copeland Act (40 U.S.C. §276c and 18 U.S.C. §874), and the Contract Work Hours and Safety Standards Act (40 U.S.C. §§327-333), regarding labor standards for federally-assisted construction subagreements.

10. Will comply, if applicable, with flood insurance purchase requirements of Section 102(a) of the Flood Disaster Protection Act of 1973 (P.L. 93-234) which requires recipients in a special flood hazard area to participate in the program and to purchase flood insurance if the total cost of insurable construction and acquisition is $10,000 or more.

11. Will comply with environmental standards which may be prescribed pursuant to the following: (a) institution of environmental quality control measures under the National Environmental Policy Act of 1969 (P.L. 91-190) and Executive Order (EO) 11514; (b) notification of violating facilities pursuant to EO 11738; (c) protection of wetlands pursuant to EO 11990; (d) evaluation of flood hazards in floodplains in accordance with EO 11988; (e) assurance of project consistency with the approved State management program developed under the Coastal Zone Management Act of 1972 (16 U.S.C. §§1451 et seq.); (f) conformity of Federal actions to State (Clean Air) Implementation Plans under Section 176(c) of the Clean Air Act of 1955, as amended (42 U.S.C. §§7401 et seq.); (g) protection of underground sources of drinking water under the Safe Drinking Water Act of 1974, as amended (P.L. 93-523); and, (h) protection of endangered species under the Endangered Species Act of 1973, as amended (P.L. 93-205).

12. Will comply with the Wild and Scenic Rivers Act of 1968 (16 U.S.C. §§1271 et seq.) related to protecting components or potential components of the national wild and scenic rivers system.

13. Will assist the awarding agency in assuring compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 U.S.C. §470), EO 11593 (identification and protection of historic properties), and the Archaeological and Historic Preservation Act of 1974 (16 U.S.C. §§469a-1 et seq.).

14. Will comply with P.L. 93-348 regarding the protection of human subjects involved in research, development, and related activities supported by this award of assistance.

15. Will comply with the Laboratory Animal Welfare Act of 1966 (P.L. 89-544, as amended, 7 U.S.C. §§2131 et seq.) pertaining to the care, handling, and treatment of warm blooded animals held for research, teaching, or other activities supported by this award of assistance.

16. Will comply with the Lead-Based Paint Poisoning Prevention Act (42 U.S.C. §§4801 et seq.) which prohibits the use of lead-based paint in construction or rehabilitation of residence structures.

17. Will cause to be performed the required financial and compliance audits in accordance with the Single Audit Act Amendments of 1996 and OMB Circular No. A-133, "Audits of States, Local Governments, and Non-Profit Organizations."

18. Will comply with all applicable requirements of all other Federal laws, executive orders, regulations, and policies governing this program.

* SIGNATURE OF AUTHORIZED CERTIFYING OFFICIAL	* TITLE
Serelia Woods	Contracting Officer
* APPLICANT ORGANIZATION	* DATE SUBMITTED
Georgia Tech Research Corporation	01/12/2012

Standard Form 424B (Rev. 7-97) Back

FORM CD-511
(REV 1-05)

U.S. DEPARTMENT OF COMMERCE

CERTIFICATION REGARDING LOBBYING

Applicants should also review the instructions for certification included in the regulations before completing this form. Signature on this form provides for compliance with certification requirements under 15 CFR Part 28, 'New Restrictions on Lobbying.' The certifications shall be treated as a material representation of fact upon which reliance will be placed when the Department of Commerce determines to award the covered transaction, grant, or cooperative agreement.

LOBBYING

As required by Section 1352, Title 31 of the U.S. Code, and implemented at 15 CFR Part 28, for persons entering into a grant, cooperative agreement or contract over $100,000 or a loan or loan guarantee over $150,000 as defined at 15 CFR Part 28, Sections 28.105 and 28.110, the applicant certifies that to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, 'Disclosure Form to Report Lobbying,' in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure occurring on or before October 23, 1996, and of not less than $11,000 and not more than $110,000 for each such failure occurring after October 23, 1996.

Statement for Loan Guarantees and Loan Insurance

The undersigned states, to the best of his or her knowledge and belief, that:

In any funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this commitment providing for the United States to insure or guarantee a loan, the undersigned shall complete and submit Standard Form-LLL, 'Disclosure Form to Report Lobbying,' in accordance with its instructions.

Submission of this statement is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required statement shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure occurring on or before October 23, 1996, and of not less than $11,000 and not more than $110,000 for each such failure occurring after October 23, 1996.

As the duly authorized representative of the applicant, I hereby certify that the applicant will comply with the above applicable certification.

* NAME OF APPLICANT: Georgia Tech Research Corporation

* AWARD NUMBER: 2012-NIST-MSE-01

* PROJECT NAME:

Prefix:

* First Name: Serelia

Middle Name:

* Last Name: Woods

Suffix:

* Title: Contracting Officer

* SIGNATURE: Serelia Woods

* DATE: 01/12/2012

Budget justification:

The project involves support for a graduate student assistant for a duration of 9 months corresponding the full academic year (Spring and Fall of 2012). In addition minimal travel support is included to allow for a trip to DC for discussions with NIST and to allow partial support for participation in the conference workshops mentioned in the statement of work.

Materials and supplies includes equipment for conducting the research including computers costing less than $2,400, software, sensing technology, and prototyping materials, plus a nominal amount for supplies specific and necessary only for the scope of this project.

Computer charges are calculated at $4,950 per year per full-time employee (current rates – we anticipate a 5% increase in year 1 of the project and every year thereafter), and are prorated based on actual amount of time worked on the project.

Fringe benefits are charged on senior personnel and research scientists at a rate of 26.9% per year; the fringe benefits charged for students is 0.015%.

Tuition remission is charged at $1104 per month per enrolled student.

Indirect rates are charged on all direct costs less equipment and tuition at a rate of 52.7%.

Project: Kitting for manufacturing applications
PI: Henrik I Christensen, Robotics @ GT, Georgia Tech

Objective:

To study representations and models for automating kitting as part of manufacturing processes.

Technical Idea:

Automated packaging has already been adopted in many supply chains applications such as beverage distribution, grocery handling, and pharmaceuticals. At the same supply chains are changing to have feeder lines to enable larger sub-assemblies to be handled independently of the main manufacturing lines. Major companies such as Boeing, Lockheed Martin, and General Motors have adopted such a model. Even in grocery distribution it is common to use totes to deliver small sized items such as toothpaste, soap, shoelaces, ... as the volume is too low to allow distribution of whole sale items. A special type of sub-assemblies is kits used for assembling a particular item such as a car-door or cable harness for an entertainment system. Today a majority of the kits used in car, aerospace and food processing are put together manually. The reason for this has been limited volume and too high engineering costs to motivate automation. The idea is here to study how methods from other areas of packaging and automation can be adopted for automation of kitting processes.

Research Plan:

Through on-going projects with companies such as General Motors, The Boeing Company and C&S WholeSale there is access to plants where kitting is utilized today. An excellent example is the Boeing plant in Charleston, SC where the 787 Dreamliner is assembled. Across the different application areas several different types of kits are used.

The simplest is the bucket model, where the key components for a particular assembly are put into a container. A worker will know when an assembly has been completed correctly due to the facts that all parts have been used.

The template model, where all pieces have a well defined position and you know exactly which pieces are where in the kits.

The harness model, where pieces are put on pegs to approximate the position of the different pieces, but localization is at best approximate.

Consequently the variability in handling is anywhere but putting items in a bucket to precise handling of objects. Irrespective, it is of interest to see how methods for automated packaging can be leveraged for automation of the kitting process. The

automation serves multiple purposes: i) to ensure a higher degree of consistency, ii) to increase volume/reduce costs, and iii) to enable a higher degree of just-in-time delivery of kits to the main manufacturing line.

For the automation it is of interest to consider a) what is a suitable underlying knowledge representation?, and b) how can existing methods for planning and execution be leveraged in the design of such systems.

Earlier research has considered use of standardized schemas for representation of plans and methods. Ideally one would like to have a knowledge representation that allow modeling of i) the components to be packages in terms of physical size, handling, weight, material, ii) specification of the "kit" (list of items and potential constraints on position/placement/order), and iii) a plan for the composition of the kit. In addition for the different parts it is of interest to consider specification of tolerances on size and placement. For interoperability one can adopt XML file formats to make it simple to generate, parse and process such data. However, it is also of interest to consider XML merely a representation for a well-defined ontology. The natural choice here is to consider the web ontology language (OWL) and to analyze how / if an ontology can be defined that is general enough to be used for all kinds of kitting applications. In addition it is of interest to see if such an ontology also could be used for other packaging applications. The overall objective is to standardize specifications for applications to a degree that would allow interoperability across application domains and vendors. Today at least 60% of the installation of a new system is due to systems engineering. Through adoption of standard models it is expected to enable a higher degree of reuse of software and thus a reduction in cost not to mention the opportunity to avoid vendor lock-in.

Given a standard ontology for definition of kits it is of interest to review current methods for planning and control to allow automation of the kitting process. There are quite a few solutions available for packaging and palletizing. The methods available will be surveyed and an interface will be developed for a few of them to allow empirical evaluation for a set of 2-3 reference scenarios.

Software is available for benchmarking of palletizing and multi-robot material handling. It is of interest to adopt this software to allow for automated evaluation of the different techniques.

The concrete efforts would include:

Q1:

- Survey of current techniques used for kitting across automotive, aerospace and food processing
- Analysis of ontology requirements

Q2:

- Proposed ontology for kitting applications
- Review of kitting ontology with 2-3 industry partners
- Participation in ICRA workshop on benchmarking for presentation of ontology

Q3:

- Implementation of the ontology using OWL with XML schemes
- Revision of benchmarking software to read / process ontology files
- Participation in IROS workshop on benchmarking

Q4:

- Implementation of interfaces for 2-3 planning algorithms
- Evaluation of performance and generality of proposed approach
- Annual report for the project.

Potential **continuation**:

If the project is continued beyond the first year the objective would be to revise the ontology based on feedback from industry partners. During the first 6 months of the 2nd year the ontology would be tested with industry partners to evaluate how their current systems could be adopted for use of the new ontology. Based on feedback from end-users such as Boeing, General Motors and C&S the ontology will be revised. A tool-suite would then be developed to enable conversion of proprietary systems to the new model, so as to ease the burden of adopting the new "standard".

Q1-2:

- Evaluation / review of ontology based on industry processes.
- Revised ontology definition

Q3-4:

- Tool-chain to enable adoption of the ontology as part of proprietary systems
- Final report for the project

The **deliverables** from the project would be:

1. Survey of current kitting methods and approaches (Month 5)
2. *Description of ontology for kitting* (Month 9)
3. Update of benchmarking software (Month 12)
4. Final report with evaluation of the proposed approach (Month 12)

Related publications:

1. S. Balakirsky, H. Christensen, Kramer.T., P. Kolhe, F. Proctor. Mixed Pallet Stacking: An Overview and Summary of the 2010 PerMIS Special Session. 9-30-2010. Proceedings of Performance Metrics for Intelligent Systems (PERMIS) Workshop.

2. S. Balakirsky, F. Proctor, T. Kramer, P. Kolhe, H. Christensen. Using Simulation to Assess The Effectiveness of Pallet Stacking Methods. 2010. Proceedings of the 2nd International Conference on Simulation, Modeling, and Programming for Autonomous Robots (SIMPAR 2010).