



U.S. ARMY
RDECOM

SPECIAL REPORT RDMR-CS-17-01

SELF-REROUTING AND CURATIVE INTERCONNECT TECHNOLOGY (SERCUIT)

Shiv Joshi

Concepts to Systems, Inc.
500 Stinson Drive
Danville, VA 24540

December 2017

Distribution Statement A: Approved for public release; distribution is unlimited.



DESTRUCTION NOTICE

FOR CLASSIFIED DOCUMENTS, FOLLOW THE PROCEDURES IN DoD 5200.22-M, INDUSTRIAL SECURITY MANUAL, SECTION II-19 OR DoD 5200.1-R, INFORMATION SECURITY PROGRAM REGULATION, CHAPTER IX. FOR UNCLASSIFIED, LIMITED DOCUMENTS, DESTROY BY ANY METHOD THAT WILL PREVENT DISCLOSURE OF CONTENTS OR RECONSTRUCTION OF THE DOCUMENT.

DISCLAIMER

THE FINDINGS IN THIS REPORT ARE NOT TO BE CONSTRUED AS AN OFFICIAL DEPARTMENT OF THE ARMY POSITION UNLESS SO DESIGNATED BY OTHER AUTHORIZED DOCUMENTS.

TRADE NAMES

USE OF TRADE NAMES OR MANUFACTURERS IN THIS REPORT DOES NOT CONSTITUTE AN OFFICIAL ENDORSEMENT OR APPROVAL OF THE USE OF SUCH COMMERCIAL HARDWARE OR SOFTWARE.

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503				
1. AGENCY USE ONLY		2. REPORT DATE December 2017		3. REPORT TYPE AND DATES COVERED Final
4. TITLE AND SUBTITLE Self-Rerouting and Curative Interconnect Technology (SERCUI)			5. FUNDING NUMBERS	
6. AUTHOR(S) Shiv Joshi				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Commander, U.S. Army Research, Development, and Engineering Command ATTN: RDMR-CS Redstone Arsenal, AL 35898-5000			8. PERFORMING ORGANIZATION REPORT NUMBER SR-RDMR-CS-17-01	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Linda K. Taylor, U.S. Army Aviation and Missile Research, Development, and Engineering Center ATTN: RDMR-CS			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.			12b. DISTRIBUTION CODE A	
13. ABSTRACT (Maximum 200 Words) The primary goal of Phase I of fabricating and characterizing autonomous self-healing current carrying composite conductors is achieved. A conductive blend of CB powder and Surlyn® pellets is prepared using microcompounder and a single screw extruder. The volume fraction of conductive filler is designed to provide conductivity comparable to traditional wires in the undamaged state for normal operation. When this blend is used as the primary conductor, damage to it can be healed by means of controlled arcing or resistive heating depending on the extent of the damage.				
14. SUBJECT TERMS			15. NUMBER OF PAGES 5	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT SAR	



Concepts to Systems, Inc.

500 Stinson Drive

Danville, VA24540

Small Business Contact

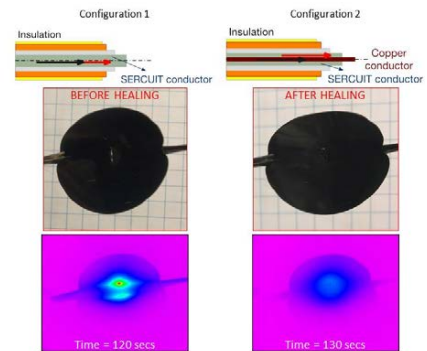
Shiv Joshi

Principal Engineer

sjoshi@concepts2systems.com

(p) 434-207-5189 x

(f)



[Click to view full size](#)

Title

SELF-REROUTING AND CURATIVE INTERCONNECT TECHNOLOGY (SERCUIT)

SBIR Topic Number

A16-101

Summary Report Type

Phase I Final

Description and Anticipated Benefits

The primary goal of Phase I of fabricating and characterizing autonomous self-healing current carrying composite conductors is achieved. A conductive blend of CB powder and Surlyn® pellets is prepared using microcompounder and a single screw extruder. The volume fraction of conductive filler is designed to provide conductivity comparable to traditional wires in the undamaged state for normal operation. When this blend is used as the primary conductor, damage to it can be healed by means of controlled arcing or resistive heating depending on the extent of the damage. In more likely wire architecture, copper conductor is surrounded by the healing/rerouting conductive blend sheath. Copper core serves as the primary current carrying conductor and the composite layer serves as an alternate current carrying self-healing pathway in case of damage to the copper wire or both. The electrical, thermal, and healing properties of these conductive blends have been studied to validate their use in electrical wiring systems. It is demonstrated that the conductive blend autonomously heals with controlled microscopic arching-induced polymer melt reflow in the close vicinity of damage to reestablish the conductive path. C2Si team successfully established feasibility of the proposed SERCUIT concepts and down selection of the technology meeting topic criteria at a proof-of-concept level. In Phase II, C2Si is partnering with the established wire manufacturer for military and civilian markets, Parker Hannifin Corporation, and a defense prime contractor, Boeing Corporation, to facilitate the transition. C2Si will license the technology to Parker Hannifin Corporation to manufacture wiring harnesses to flow down requirements by Boeing. Further maturation of the technology will open up wider utilization of this technology in military as well as much wider commercial systems market. This capability could be beneficial in automotive sector as well that already uses a large quantity of wiring that only going to increase with autonomous vehicles on horizon and demand for reliable and robust wiring solutions. It will also open up boat and ship structural applications. In general the technology will be suitable for reliable transportation systems, space exploration systems and satellites where failure can results in extreme losses. Many countries are extending the life of their military fleet through service life extension programs involving upgrades and retrofits rather than purchasing new aircraft. Navy data on wiring issues suggests that as many as one million man-hours are spend annually in troubleshooting, isolating,

Contract Number

W911W6-17-C-0029

Proposal Number

A163-101-0037

locating and fixing wiring faults. Naval Air Systems Command (NAVAIR) data suggests that nearly as many hours are spent on unscheduled wiring maintenance as on scheduled maintenance. Further, the data collected by NAVAIR indicated that chafing contributed to more than a third (37%) of all wiring failures on Navy aircraft during the period 1980-1999. Moreover, despite the fact that chafing, or the erosion of insulation and the exposure of conductor, is a known problem, and the tools to resolve it are available, analysis of data from the years 2000 to 2004 show that chafing remained the major wire failure modes on Navy aircraft. Fully 30% of aircraft with more than 70,000 hours were found with severe chafing and bare wires. Based on these indicators, C2Si will be in a position to quickly commercialized our autonomous healing and rerouting technology.

Disclaimer: The appearance of a report or a hyperlink does not constitute endorsement by the Department of Defense or the Department of the Army. Distribution A: Approved for public release; distribution unlimited.