NextFlex Special Call:

The purpose of this Request for Information is to provide public notification of research areas of interest to NextFlex in support of the Department of Defense (DoD) and advancing FHE manufacturing in the United States.

BACKGROUND

Problem Statement:

Problem Statement: Engineers need a method to accurately stitch together adjacent x-ray volumes and correct for warping in PCBs in order to form a cohesive 3D representation of the CCA.

Context:

To effectively deal with emerging technical challenges, the Department of Defense must use innovative technologies, develop a resilient workforce, and embrace new ways of conducting business. The Tools and Techniques (T2) Program offers a repeatable and consistent process to quickly evaluate and adopt new capabilities that are essential for accomplishing mission-critical goals. The T2 Program aims to identify, evaluate, and act on innovation opportunities that are aligned with mission objectives and enable the rapid pursuit and adoption of transformative capabilities.

Department of Defense engineers need to non-destructively reverse engineer circuit card assemblies (CCAs), either to redesign obsolete boards or for hardware trust and assurance. In the CCA reverse engineering process, engineers scan CCAs using x-ray computed tomography, such as North Star Imaging systems, to generate a set of images representing internal printed circuit board (PCB) layers. Depending on the size of the CCA, these x-ray scans may only capture a specific section of the board, representing a volume of different layers and sections of a board. As a result, multiple x-ray volumes capturing sections of the board need to be stitched together to form a cohesive 3D representation of the CCA. The data associated with these x-ray volumes may vary anywhere from 4 GB to over 40 GB per volume. However, most PCBs in a CCA contain warping due to manufacturing defects, long-term usage, and temperature distortions. For multilayer PCBs, this warping causes interference between adjacent layers, thereby limiting understanding of the internal PCB design. Additionally, engineers must keep the PCBs populated with components while scanning, and the board components must function within manufacturer specifications following x-ray scanning.

REQUIREMENTS

Please provide a technical paper outlining an approach to solving the X-Ray stitching and de-warping problem. Technical papers do not have any page limit; any figures or tables should be listed as addendums to the paper. This approach should consider the following objectives:

Objectives

- Solution should de-warp an x-ray CT volumetric reconstruction of a multilayer PCB in order to align all internal layers to the PCB to 2D planes
    - Solution should be compatible with high-resolution (20-40 µm) x-ray volumetric data generated from industrial x-ray computed tomography systems

    - Solution should align the x-ray volume to a known X, Y, Z coordinate system
    - Solution should manipulate the x-ray volume such that internal PCB layers are transformed into parallel 2D planes
    - Solution should enable the user to extract internal PCB layers as 2D images with minimal interference from adjacent PCB layers
- Solution should join adjacent X-Ray volumes capturing sections of a CCA
    - Solution should ensure adjacent x-ray volumes are fully aligned in the X, Y, and Z axes before stitching together the adjacent volumes
    - Solution should account for and correct for any overlapping of segments within the same layer when combining adjacent x-ray volumes
    - Solution should join adjacent x-ray volumes such that internal PCB layers in the adjacent volumes are aligned and merged to the same layer
- Solution should be compatible with the following file formats and data types:
    - .tif
    - .vgl
    - .vol
    - .raw
- Solution should be compatible with data generated through x-ray computed tomography
    - Solution may be compatible with other imaging modalities as identified
    - Solution may be suitable for legacy datasets as identified

Note: Data can be made available to test the solution on an as-needed basis.

As part of the technical paper, please provide a Rough Order Magnitude (ROM) for executing the proposed solution. As applicable, please break cost into development milestones and tie components of the proposed solution to each milestone (e.g., Phase 1, Phase 2, etc.). Technical papers and ROM costs will be reviewed by the sponsoring organization to determine possible alignment for a potential project.

This Special Call does not constitute a commitment by NextFlex to contract for any supply or service.

DUE DATE: COB May 15, 2023

Questions, Email proposal@nextflex.us.

Proposal responses should be submitted to proposal@nextflex.us.