

# Universal Computed Tomography



## INTRODUCTION

X-ray Computed Tomography (CT), better known as “CAT” scan in the medical field, is generally not used for inspection of munitions, because of high cost and slow throughput. Full volume CT is a very desirable method of inspection in that all components of a complex object can be seen and measured in three dimensions. TACOM-ARDEC recognized that if the cost and throughput were made reasonable, full volume CT would be the inspection method of choice.

To solve this problem, TACOM-ARDEC has successfully built its “Universal Computed Tomography” (UCT) system. The UCT system was purposefully designed so that it can inspect a host of end items, not just one. By changing the ordinary paradigm from a custom built CT system to a generic CT system, the cost per part inspected has been reduced ten-fold or more. The UCT system was purposefully designed using the latest tomograph construction algorithm, that is cone beam geometry, which increases the throughput a hundredfold over others and simultaneously makes digital radiograph images. Hence ARDEC’s UCT system is a full blown Digital Radiograph (DR) system as well as the state-of-the-art CT system. In the DR mode the system creates images 400 times faster than in the CT mode. Many inspections only require CR with a fantastic throughput. ARDEC has used the system for inspection of many items.

In full volume CT all voxels are contiguous so that the intensity in every voxel of the object is calculated. Competing systems generally are partial volume, that is, voxels are chosen in non-adjacent planes through the axis of rotation. The missing voxels may have defects which will not show up in these competing systems.

## UCT SPECIFICATIONS

The UCT system was built with a 450 KEV x-ray source so that it can penetrate most munitions. The source has two spot sizes, one for speed and the other for fine precision. All components are remotely operated by the software automatically, so that once an inspection definition has been made, the system automatically moves the objects, creates the DR and CT images.

Cone beam CT acquires a full 2-D radiograph for each small rotation of the object. The x-ray detector component is a high intensity x-ray scintillator which is optically coupled to a 16 bit low noise CCD camera. The replaceable camera lens determines the pixel resolution in the DR images, which in turn affects the voxel resolution in the tomographic images. A single DR can image either a six by six inch region of the object, or a thirteen by thirteen inch region of the object. Exposure time is set by the operator with automated assistance by the system.

Both radiographic and tomographic images are displayed by very powerful and simple to use imaging software. ARDEC’s UCT system has the most advanced display software of any known CT system.

All parameters are set by the operator with assistance by the software. Often a setup for one item can be used for another similar item. It is the software interfaced to the various incremental motors which make the system capable of inspecting so many items.

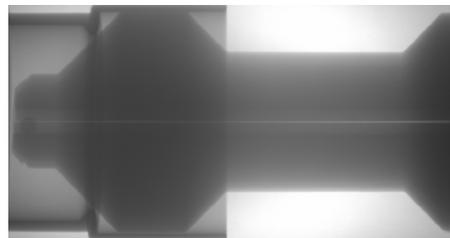
## APPLICATIONS

Items already inspected using the UCT are as diverse as forty millimeter fuzes, 90 millimeter thermobarric projectiles, 120 millimeter kinetic energy tank rounds, composite material sabot, back-up batteries for the Wide Area Munition, grenade fuzes, 60 millimeter mortar rounds, and 120 mortar rounds.

## TECHNOLOGY TRANSITION

The UCT system was built for TACOM-ARDEC under a Small Business Innovative Research (SBIR) contract. Under the Congressional laws of the SBIR program, the contractor can build systems for any Federal government entity without further competition. Competition was achieved during the SBIR source selection. ARDEC has and will continue to work closely with its munition fabricators to transition this technology into the production plants. ARDEC will provide early on tests using its UCT system to create inspection process before the plants have their UCT system installed.

ARDEC aided the development of a similar system for the Allegheny Ballistic Laboratory. Part of ARDEC’s mission is the aiding of other government agencies and commercial companies in the transition of this technology for their use.



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