

ClearRead CT | Vessel Suppress

Empowering Clinicians

ClearRead CT | Vessel Suppress is a novel machine learning solution that removes the single largest impediment to fast and effective nodule detection.

Building ClearRead CT | Vessel Suppress

ClearRead CT | Vessel Suppress was created using massive amounts of data in order to ensure accurate, consistent performance across all nodule types (solid, part-solid, ground glass), CT manufacturers, and acquisition protocols (e.g., contrast vs non-contrast exams).

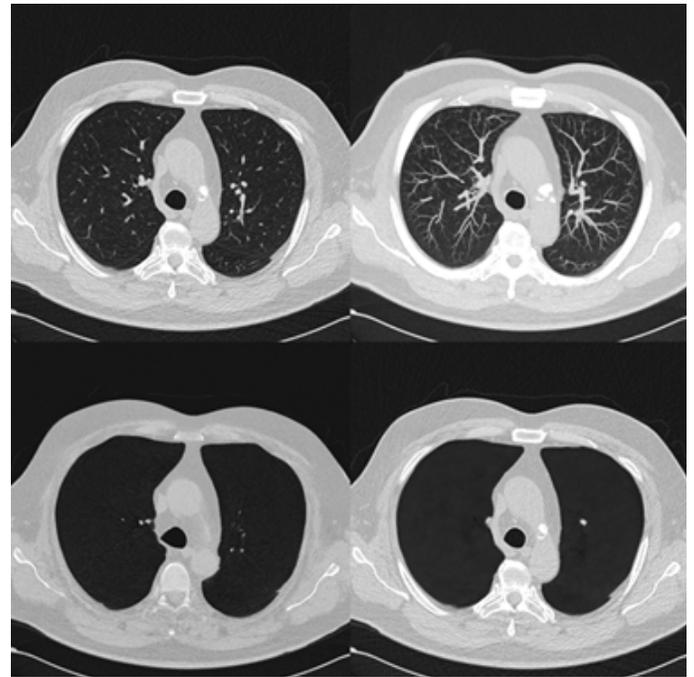
Riverain's proprietary data generation methods allow highly accurate, synthetic nodules to be precisely embedded in normal CTs to support the creation of 1,000s of targeted training cases. Adequacy of training data, both in terms of quality and quantity, is critically important to machine learning solutions and has been a significant obstacle to fielding systems that meet clinicians' expectations. Riverain's simulation and modeling capabilities are used to create varying nodule properties (morphology, density, type) that can be embedded in standard CTs at prescribed locations (lower, mid, upper lung) and with varying degrees of difficulty based on proximity and/or connection with normal structures. Collectively, this data is then used to train deep neural networks that remove normal structures from the standard CT, but retain the tissue associated with nodules.

The result, an intuitively pleasing vessel suppressed series specifically designed to aid in nodule detection, but without the compromises associated with MIP/MinIP reconstructions.

Beyond Standard Intensity Projections

Maximum and minimum intensity projections are standard tools in the radiologist's toolbox. Use of such volumes is common place; however, such methods suffer from known limitations due to the simple, standard image processing methods used. The figure in the top right shows a single slice of Vessel Suppress compared to a MIP and MinIP. This example is noteworthy as it contains a left hilum false negative, missed by all four radiologists who read the case. Note that neither standard MIP nor MinIP improved lesion conspicuity, whereas the Vessel Suppress image results in a lesion that is hard to miss.

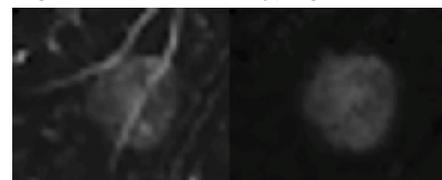
This vastly improved result stems from the methodologies used in the ClearRead CT | Vessel Suppress development process that incorporates a range of techniques, including: acquisition normalization, multi-scale image processing, and the power of deep learning enabled through sophisticated data modeling efforts.



Top left: Original | Top right: MIP
Bottom left: MinIP | Bottom right: ClearRead CT | Vessel Suppress

Beyond Nodule Detection

Vessel Suppress not only enables improved nodule detection by eliminating obscuring normal structures, it also supports improved nodule characterizations for all nodule types. Improved characterization derives, in part, from precise segmentation of nodule boundaries. Aside from volumetrics, the Vessel Suppress series enables a truly unique view on non-solid nodules. The figure below shows a ground glass nodule with intersecting vascular structure. As shown, Vessel Suppress is able to remove vascular structures without introducing artifacts, thus improving nodule density estimates. Through the suppression of vascular structures within ground glass nodules, Vessel Suppress removes much of the guesswork in nodule typing.



ClearRead CT | Vessel Suppress Chip

The functionality enabled by Vessel Suppress, as exemplified in the chip above, is profoundly different than past computer aided detection (CAD) technologies.

Key Advantages

- Improved detection of all nodule types including, solid, part-solid and ground glass
- FDA cleared for concurrent reading allowing radiologists to utilize the original and ClearRead CT images simultaneously
- Enterprise wide capability that allows “plug-in” ability across all CT manufacturers

Acquisition Normalization and Vendor Neutrality

ClearRead CT handles a broad range of acquisition protocols, a notoriously difficult problem for computer aided detection systems. Riverain utilizes adaptive algorithms so each scan is normalized for factors such as noise, reconstruction kernels, and slice thickness in a systematic fashion. This process enables ClearRead CT to operate across your entire network, whether using data from older scanners, or data from state of the art hardware.

Installation

The acquisition normalization technology supports rapid installation of ClearRead CT based on the elimination of the requirement to tune to specific scanners. ClearRead CT is designed to be computationally efficient, allowing it to be installed on existing hardware as a virtual application.

Reader Study

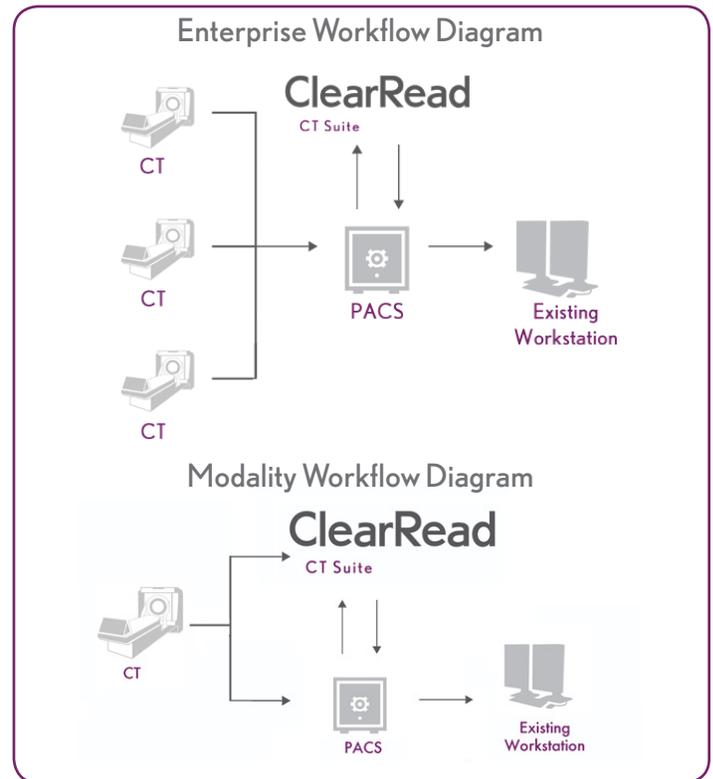
As part of an independent reader study, ClearRead CT was found to reduce radiologists reading time by 26%, and decrease the number of missed actionable nodules by 29% across solid, part-solid and ground glass nodules.

26%
Reduction in
Reading Time¹

29%
Reduction in
Missed Actionable
Nodules¹

Workflow

The Vessel Suppress volume is exported as a secondary series into your existing PACs, where it is easily preconfigured to suit your viewing preferences.



“Riverain’s ClearRead CT has been deployed as a part of our routine Chest CT exams, including patients in our Lung Cancer Screening Program. The ClearRead CT technology has helped us to detect lung nodules that may have otherwise been missed. Based upon our early experience, the workflow is faster and more accurate than existing technologies.”

- Dr. Jared Christensen, Duke University Medical Center

References

1. Riverain Technologies. ClearRead CT, FDA Reader Study Results, 2016.

About Riverain

Riverain Technologies™ is a medical software innovator that develops solutions to aid radiologists in the early detection of disease. With the use of Riverain’s ClearRead X-ray Suite and ClearRead CT, radiologists are able to optimize the use of existing equipment for enhanced image interpretation. This enables radiologists to better utilize their diagnostic expertise in image interpretation for identification of diseases, such as lung cancer.