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Computer-Aided Detection & Visualization of Pulmonary Embolism

Pulmonary embolism (PE) is a common cardiovascular emergency. Mortality rates approaching 30% are common with undiagnosed PE, but they fall to 2% with early diagnosis and treatment, thus, quick and accurate diagnosis is critical. Suspected PE is typically diagnosed with CT pulmonary angiography (CTPA), but this technique has issues with interpretation of intricate branching structures, artifacts that may obscure or mimic embolisms, suboptimal contrast, and inhomogeneities. Computer-aided detection (CAD) systems have improved diagnostic capabilities; however, to achieve a clinically acceptable sensitivity, existing CAD systems generate a high number of false positives, imposing extra burdens on radiologists.

Researchers at Arizona State University have developed novel approaches for automated computer-aided detection of emboli in CTPA. One technique automatically registers the vessel orientation in a display, providing compelling demonstration of arterial filling defects, if present, and allowing the radiologist to thoroughly inspect the vessel lumen from multiple perspectives and report any filling defects with high confidence. Another uses deep neural networks and vessel-aligned multi-planar representations to eliminate false positives. A third technique automatically and robustly detects and marks central emboli at CTPA using a rule-based approach for simplicity and low computational cost. Yet another technique creates and presents vessel-oriented images that provide consistent, compact and discriminative representation to enable a radiologist to distinguish PE from PE mimics. It also supports multi-view visualization to maximally reveal and fill defects.

The flexibility of these systems, coupled with their precise detection of both acute and chronic PE, significantly reduces radiologist workload and improves the efficiency and accuracy of PE diagnosis in CTPA.

Potential Applications

- Accurate diagnosis of PE in CTPA images
  - Can also detect central PE

Benefits and Advantages

- Detects both acute and chronic pulmonary emboli

- Allows visualization of vascular intensity levels and local vascular structure and occlusion

- Navigates the vessel based on its local structure

- Enables thorough inspection of the vessel lumen from multiple perspective

- Incrementally reports any detection to facilitate real-time support

- Compact—concisely summarizes the 3D contextual information around an embolus

- Consistent—automatically aligns the embolus according to its vessel orientation

- Expandable—naturally supports data augmentation for training

- System for central PE detection is 96% sensitive at .59 false positives per data set

- Allows for fast training of a high-performing CAD system, even in the absence of deep architectures and large labeled training set

For more information about this opportunity, please see

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For more information about the inventor(s) and their research, please see   Dr. Liang's departmental webpage