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Anatomical Clutter in Medical Image Perception

Medical image perception is a difficult task, and despite advances in imaging technology error rates of up to 30% still persist. The medical image interpretation task requires cognitive processes such as perception, comprehension, reasoning, decision-making and problem solving, all of which are affected by knowledge, memory and reasoning strategies as well as their biases. Understanding the processes that underlie expert performance in the detection of pathology has not yet been fully achieved.

A conventional medical image, such as a chest x-ray, is a 2D representation of the 3D anatomy. Fully understanding the image means having a 3D mental representation of the anatomy or template to which the image can be compared. One also needs accurate anatomic-pathologic schemas leading to perceptual differentiation of abnormalities. Experts generally detect pathology within 1 or 2 seconds of viewing an image, as they are sensitive to pathology and can attenuate or nullify all the anatomical detail in an image. This is analogous to mentally applying a pre-whitening filter to the image data, and removing anatomical clutter. The greatest motivation for the development of 3D radiographic imaging is that it removes anatomical background clutter that may decrease the conspicuity of pathology.

Currently most radiology trainees are instructed on how to classify abnormalities, whereas it would probably be better to initially instruct them on how to gather the holistic impression of the image such as normal anatomy (and variants) so that they can then fine-tune the perception of pathology. There is no short cut; this requires a great deal of practice and feedback.