

AAPM Session: Multimodality and Multidimensional Imaging

The Clinical Perspective – Multimodality and Multidimensional Imaging

Modalities like optical, CT, MR, PET/SPECT and US are used separately, but can be combined. Multimodality imaging is necessary when the results of two (or more) modalities differ, and each does something useful but not everything that's required. We will consider several practical examples: residual or recurrent tumor after treatment, eloquent cortex in a brain lesion is nearby, drug effect in situ – especially for cytostatic agents, control of thermal ablation, vulnerable plaque, evaluation of gene therapy, and assessment of revascularization benefits depending on tissue viability. All of these scenarios can be detected in one modality, where another provides a morphological reference useful for guidance in therapy.

Not only are imaging modalities synergistic, but their performance can be altered and utility extended using exogenous agents, such as contrast media, radiopharmaceuticals, and other targeted compounds with desirable in vivo biological and physical characteristics. Optimizing the combination of modalities, agents, data acquisition, image reconstruction, visualization and analysis can be challenging, but may provide unique capabilities that no single technique could offer.

We will evaluate the state-of-the-art for combining modalities in animals and show how this could translate to clinical practice, recognizing the impediments of cost, complexity, reliability, cross-talk, and safety/regulatory restrictions. The need and potential for multimodality techniques and systems already far exceeds what's currently available, so we can identify some unsolved problems where their benefits are not yet available.

Educational Objectives

1. Understand the synergy between modalities (optical, CT, MR, PET/SPECT, US), contrast agents or tracer compounds, and post-processing image analysis that provides multimodality and multidimensional capability
2. Toprove examples of how multimodality/multidimensional imaging can solve clinical problems in diseases of the brain, cardiovascular system, cancer, and for regenerative medicine
3. To identify several unsolved problems where multimodality/multidimensional imaging may provide clinically useful solutions