

# FUSED IMAGES FOR COMBINED ASSESSMENT OF MYOCARDIAL PERFUSION AND FUNCTION

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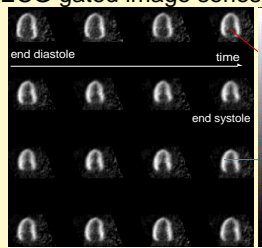
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## Introduction

Simultaneous assessment of myocardial regional perfusion (or metabolism) and function using gated SPECT or PET has great clinical value. The best way to synthesize the complementary regional perfusion and function information is still uncertain: function is often assessed by looking at the ECG gated image series in cine mode while perfusion is evaluated by considering the sum image of the gated image series. We propose a new approach to look at regional perfusion and function simultaneously using a single fused image.

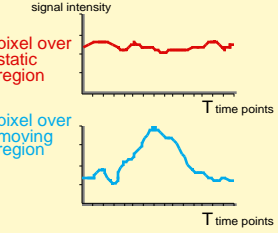
## Method

### 1. Data



ECG gated image series

Corresponding pixel Time Activity Curves (TACs)



signal intensity

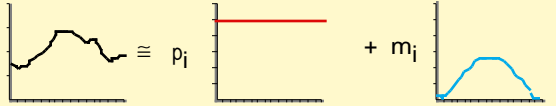
T time points

pixel over static region

pixel over moving region

### 2. Model

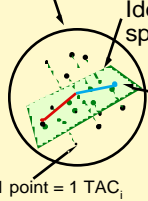
Any TAC corresponding to pixel  $i$  can be written as a linear combination of a flat TAC corresponding to motionless tissue and a roughly one-harmonic TAC corresponding to moving tissue.



$$\forall i \text{ TAC}_i(t) \equiv p_i \cdot \text{constant}(t) + m_i \cdot \text{moving}(t)$$

### 3. Estimation of the model parameters

T-dimensional space including all  $\{\text{TAC}_i(t)\}_{t=1, T}$



Identification of a 2D "main feature" space  $\mathbf{S}$  so that:

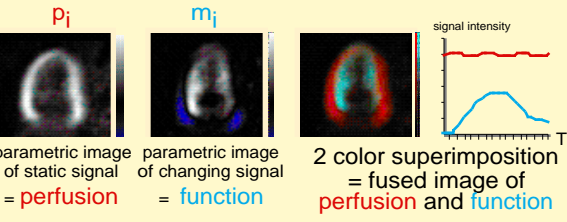
$$\sum_i \text{dist}(\text{TAC}_i, \mathbf{S}) \text{ is minimum [1]}$$

Identification of **constant(t)** and **moving(t)** in  $\mathbf{S}$  so that [2]:

- $\text{dist}(\text{constant}, 1_T)$  is minimum
- $p_i \geq 0$  for any  $i$
- $\text{moving}(t) \geq 0$  for any  $t$
- $\text{moving}(t)$  includes a single maximum

1 point = 1 TAC<sub>i</sub>

### 4. Creation of the fused images



$p_i$   $m_i$

parametric image of static signal = perfusion

parametric image of changing signal = function

2 color superimposition = fused image of perfusion and function

signal intensity

T

## Assessment of the method

### 1. Data

Nine patients with coronary artery disease

Each patient underwent within 2 weeks:

- a 5 mCi FDG gated PET scan (16 time points)
- a ~4 mCi TI-201 gated SPECT scan (8 time points)

The FDG PET data and the TI-201 SPECT data were resliced into 4 "long axis" 128 x 128 slices

### 2. Processing

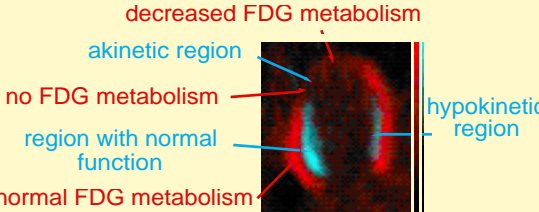
For each patient:

Calculation of the 4 FDG PET fused slices (5 sec.) (all slices were processed simultaneously)

Calculation of the 4 TI-201 SPECT fused slices (5 sec.)

Visual comparison of the perfusion / function pattern from the FDG PET and TI-201 SPECT scans

### 3. Results



decreased FDG metabolism

akinetic region

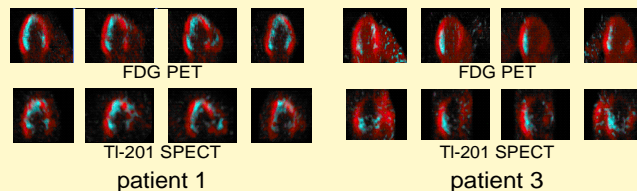
no FDG metabolism

region with normal function

normal FDG metabolism

hypokinetic region

Example of FDG PET fused image (patient 4)



Examples of comparison between FDG PET fused images and TI-201 fused images

## Discussion and Conclusion

A single fused image can be created from a gated PET or SPECT time series for simultaneous visual regional assessment of perfusion (or metabolism) and function. For all patients, excellent visual agreement was found between the perfusion/function patterns seen from the FDG PET and from the TI-201 SPECT scans, showing the relevance and the robustness of the fused images.

## References

[1] Benali et al, Phys. Med. Biol., 38: 1065-1080, 1993.  
[2] Buvat et al, Phys. Med. Biol., 43: 1695-1711, 1998.

Processing has been performed using the developer edition of the Pixies software ([www.apteryx.fr/pixies](http://www.apteryx.fr/pixies))