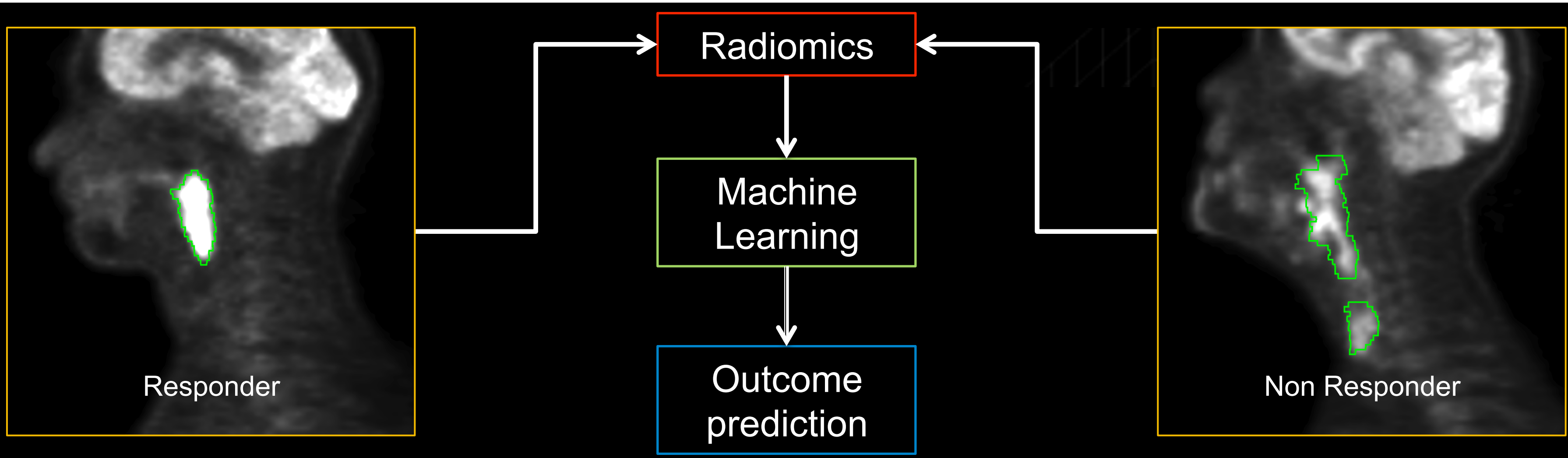


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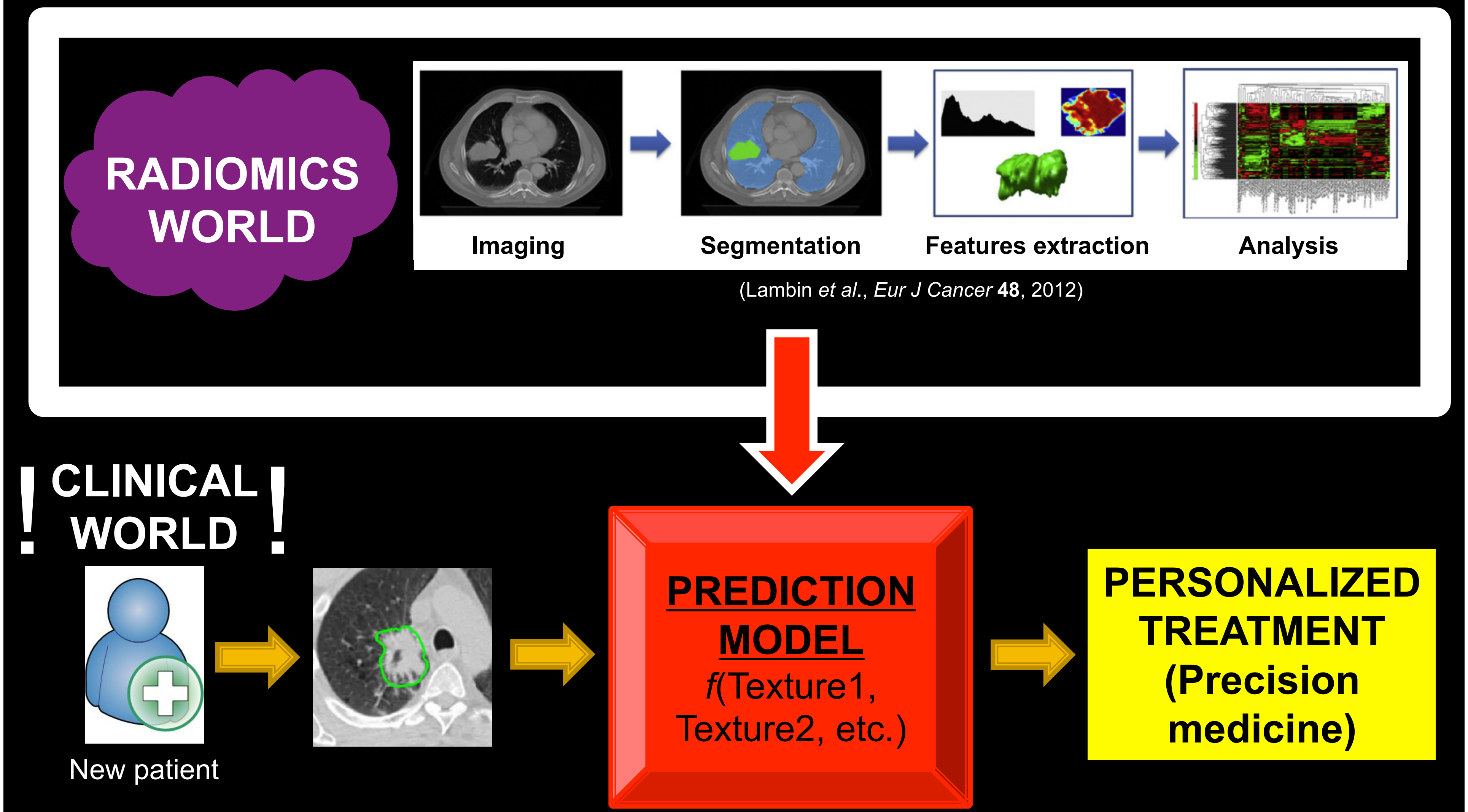
# Enhancement of multimodality texture-based prediction models via optimization of PET and MR image acquisition protocols: a proof of concept

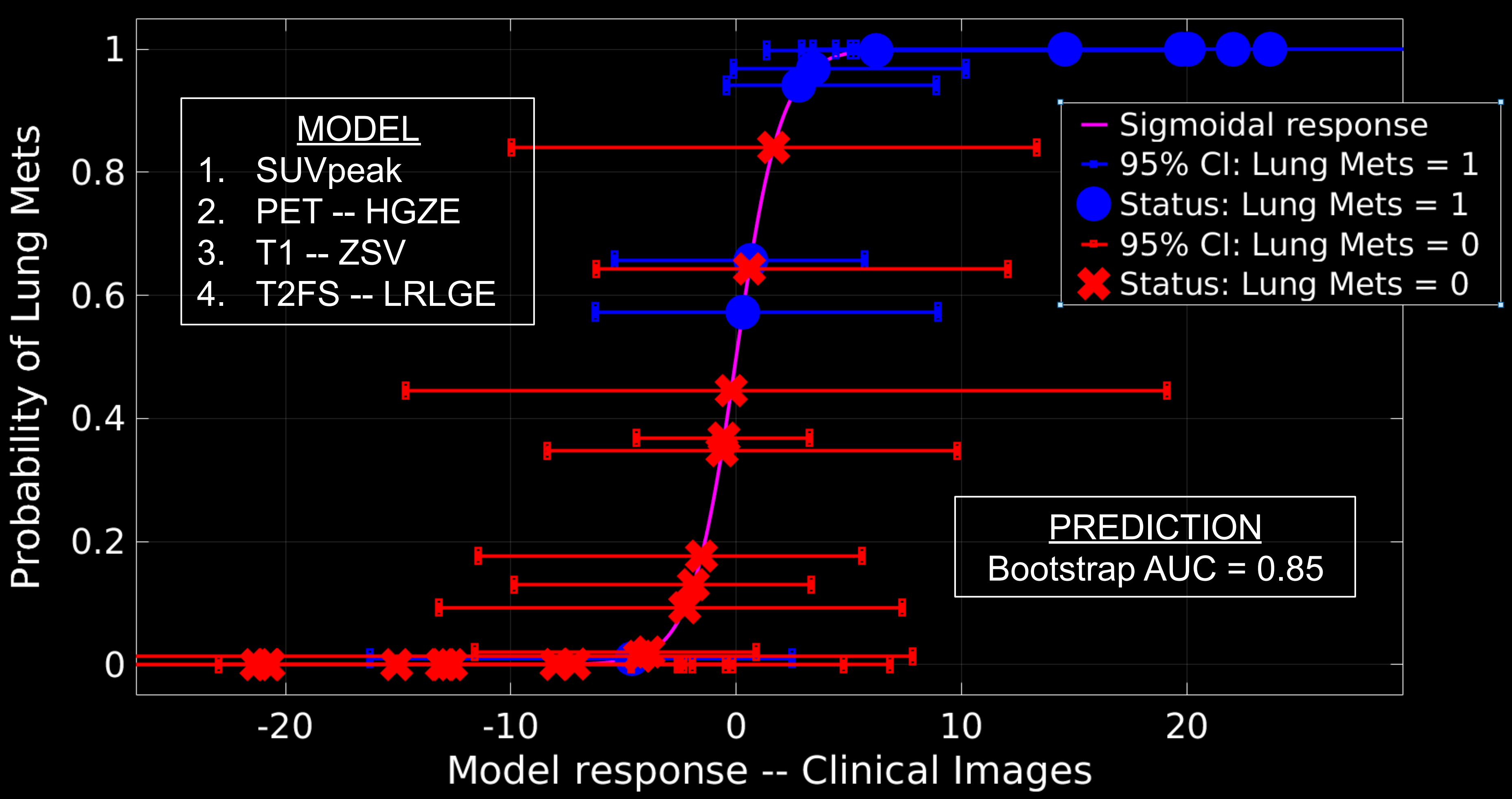
McGill University

# RADIOMICS: MAJOR OBJECTIVE



# MOTIVATION OF STUDY

## FDG-PET/MR texture-based model for lung mets prediction in soft-tissue sarcoma (STS) cancer



# IMAGE ACQUISITION INFLUENCES TEXTURES

## PET ACQUISITION PARAMETERS

- 2D versus 3D modes
- Span
- Time of acquisition

Galavis PE *et al* 2010 *Acta Oncol.* **49** 1012

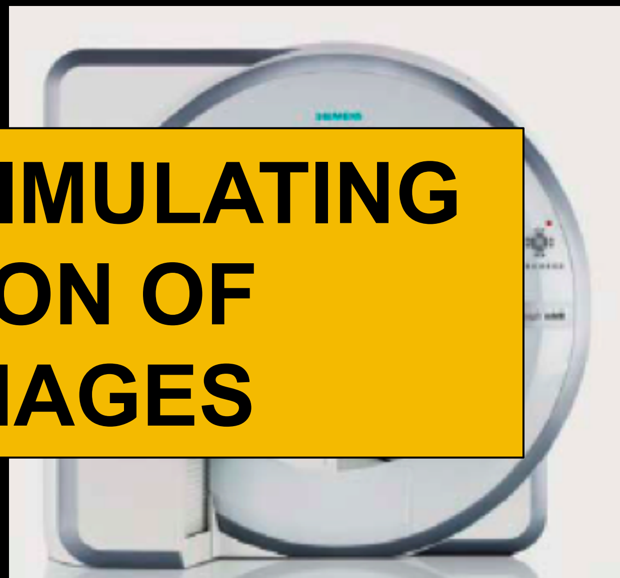
## MRI ACQUISITION PARAMETERS

- Number of acquisitions (NAs)
- Repetition time (TR)
- Echo time (TE)
- Sampling bandwidth (SBW)

Mayerhoefer ME *et al* 2009 *Med. Phys.* **36** 1236

# GOAL OF STUDY

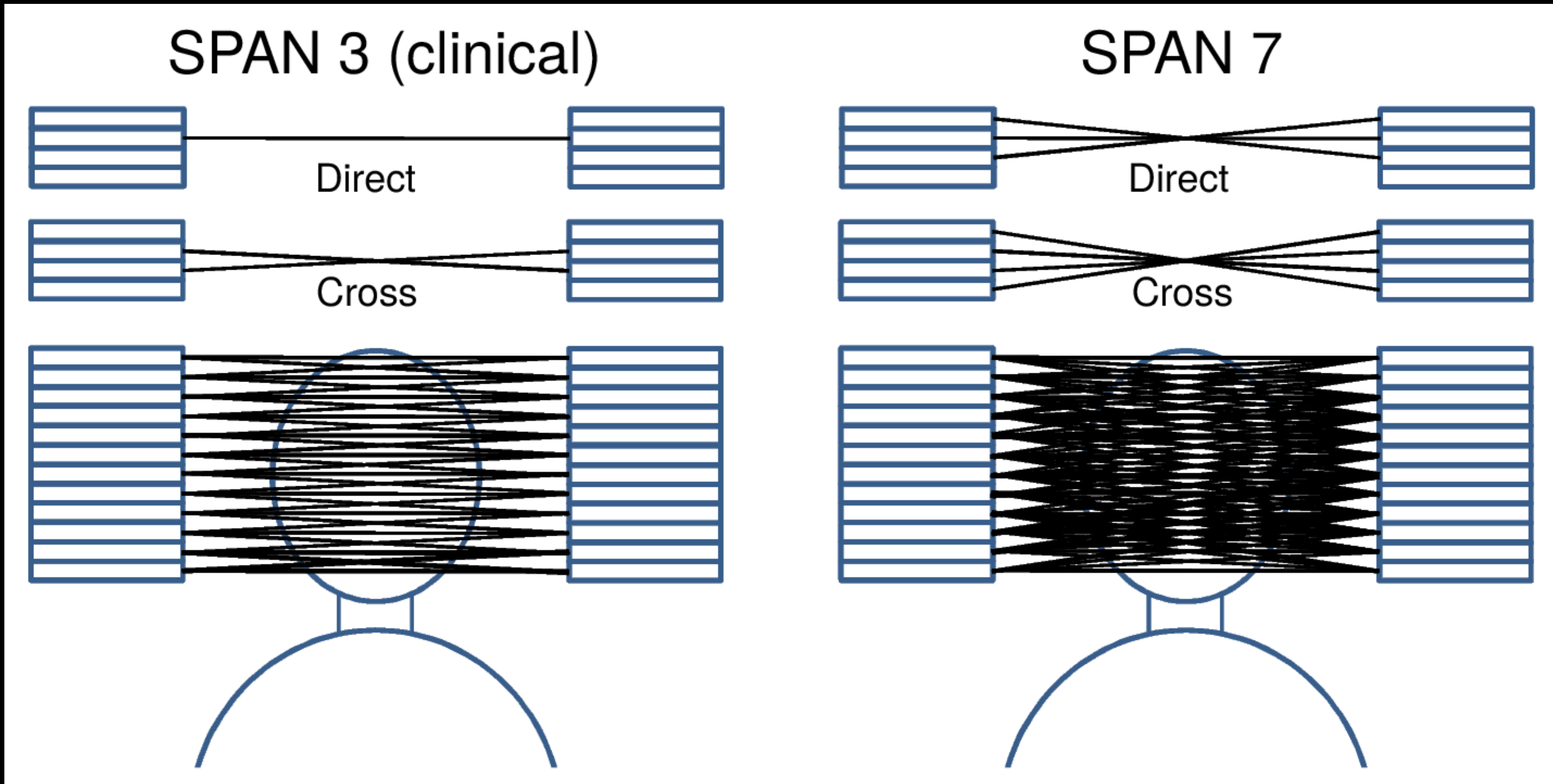
! ENHANCE TEXTURE-BASED PREDICTION MODELS THROUGH THE OPTIMIZATION OF PET AND MR IMAGING ACQUISITION PHYSICS !



**BY NUMERICALLY SIMULATING THE ACQUISITION OF PET AND MR IMAGES**

# PET physical parameter: SPAN

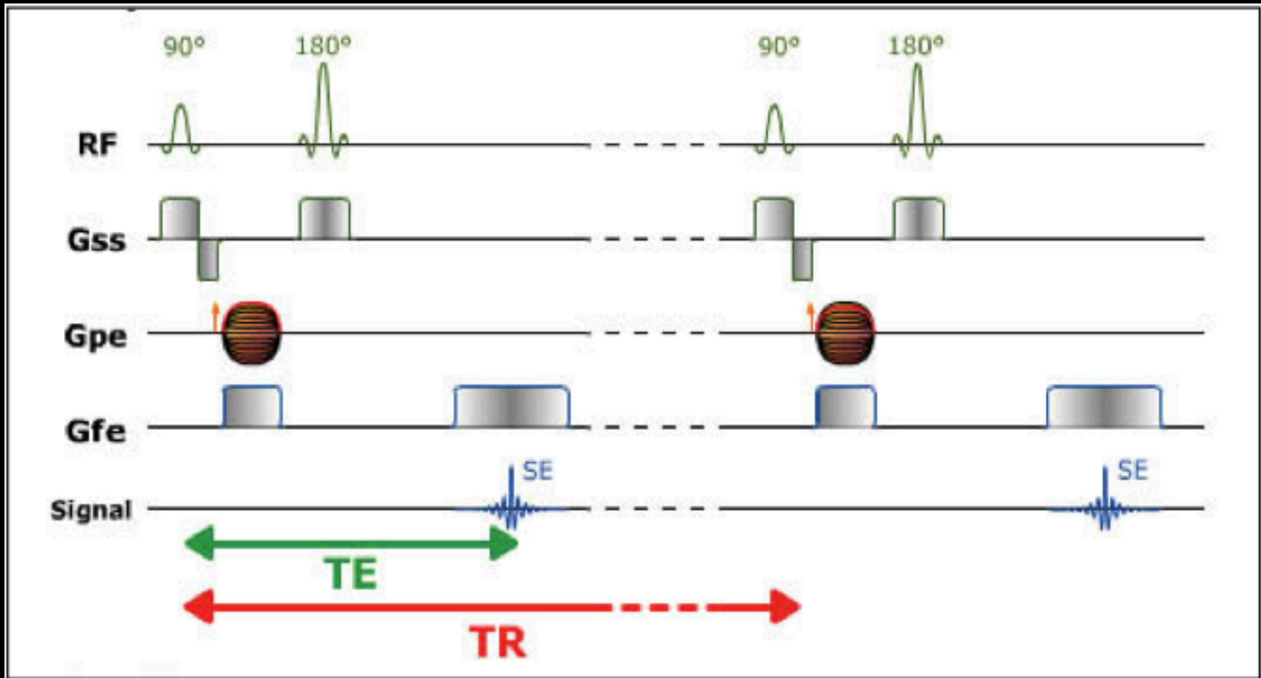
Amount of cross-talk allowed between slices



# MRI physical parameters: TR,TE

TEc : Echo time (clinical)
TRc : Repetition time (clinical)

SPIN-ECHO SEQUENCE

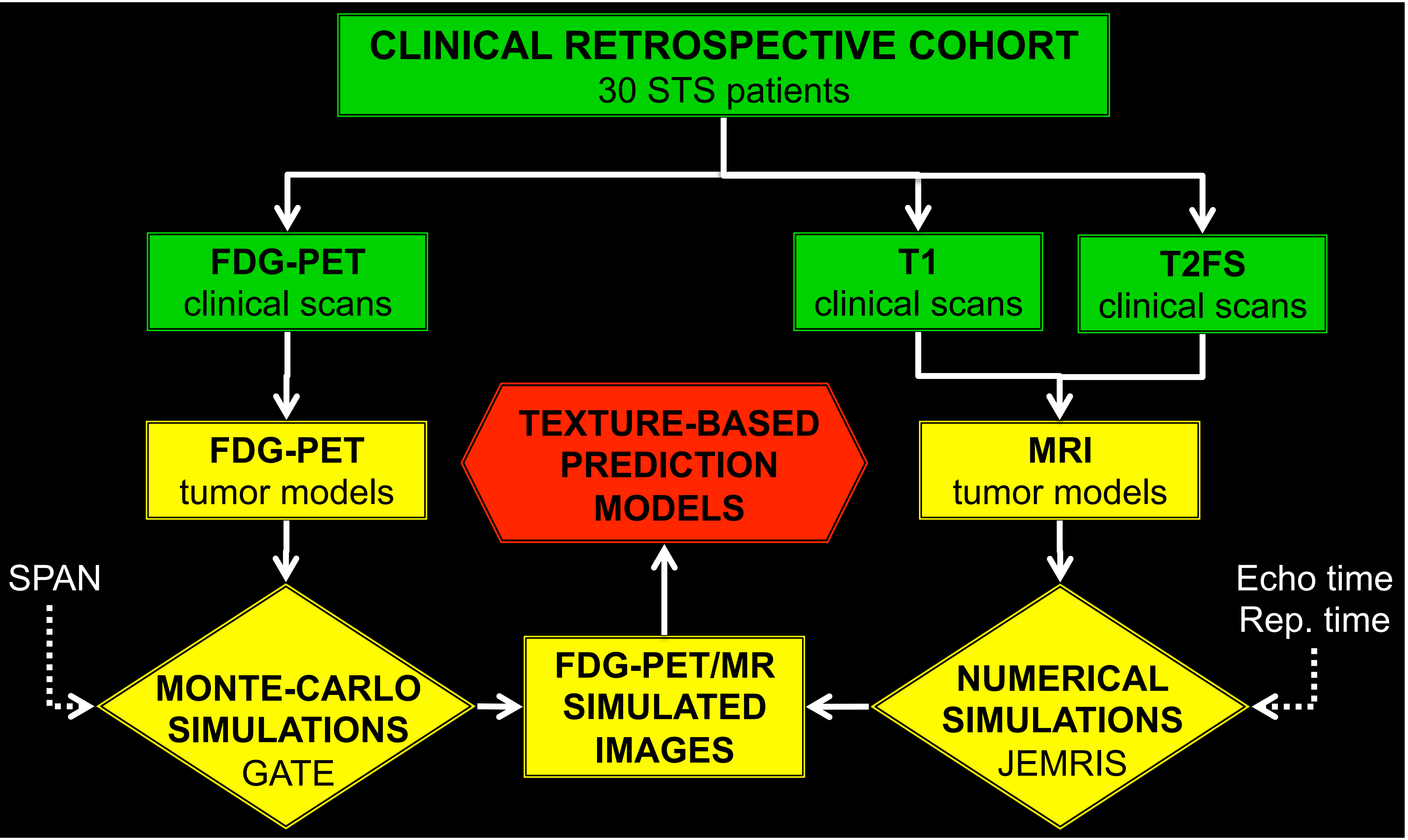



(http://www.imaios.com/en/e-Courses/e-MRI/MRI-Sequences/Spin-echo)

**T1-weighted image**
- TEc << T2
- TRc ~ T1

**T2-weighted image**
- TEc ~ T2
- TRc >> T1

# METHODOLOGY



# EXPERIMENTS

## IMAGING SIMULATIONS

→ PET
- SPAN: 3,5,7,9,11,13,15,17
- Clinical SPAN: 3

→ T1
- TR: (1/3,1/2,1,2,3) * TRc
- TRc of (492 ± 81) ms

→ T2FS
- TE: (1/3,1/2,1,2,3) * TEc
- TEc of (77 ± 12) ms

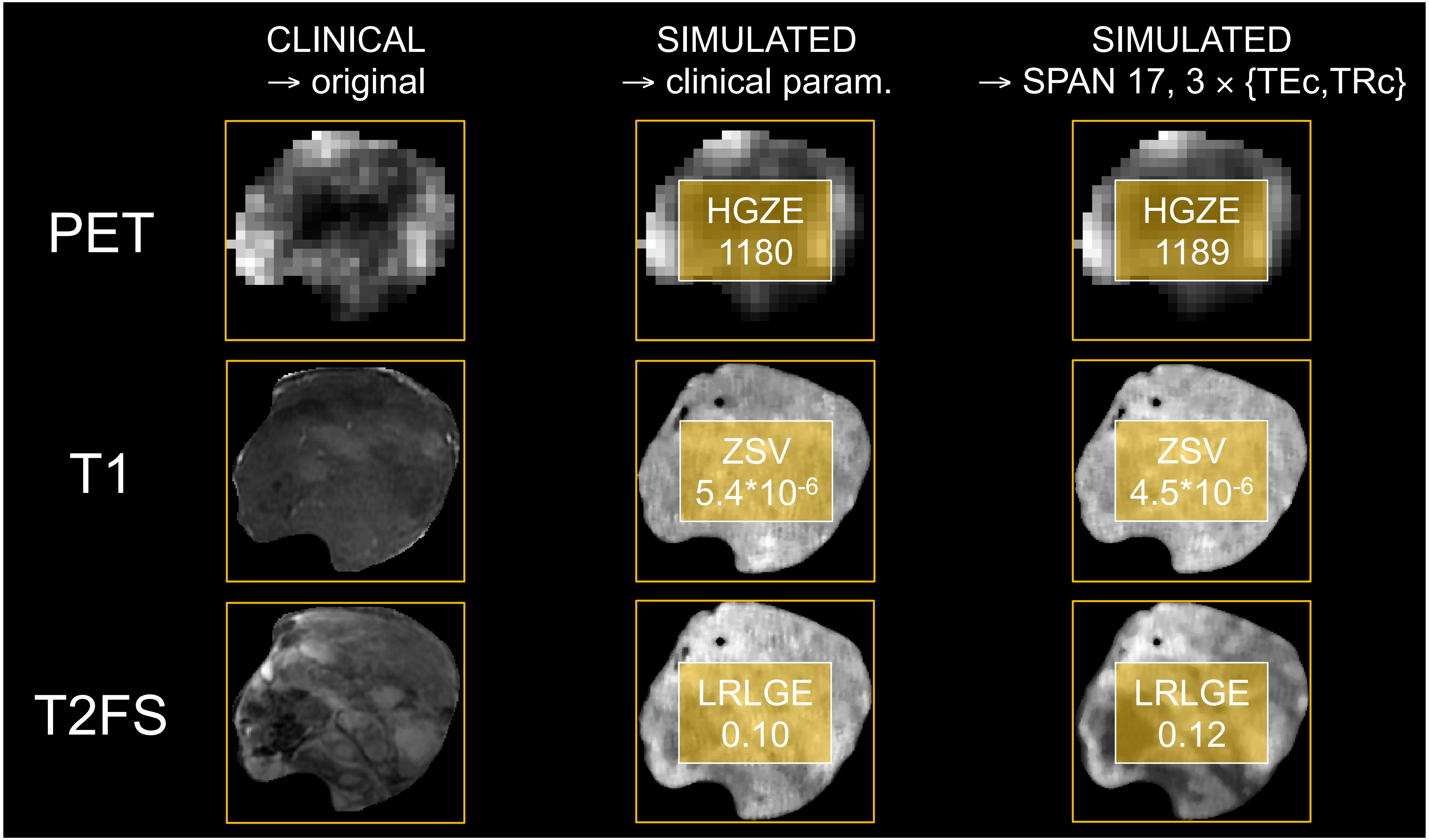
## PREDICTION MODELS EVALUATION

→ Variables
- SUVpeak
- PET -- HGZE
- T1 -- ZSV
- T2FS -- LRLGE

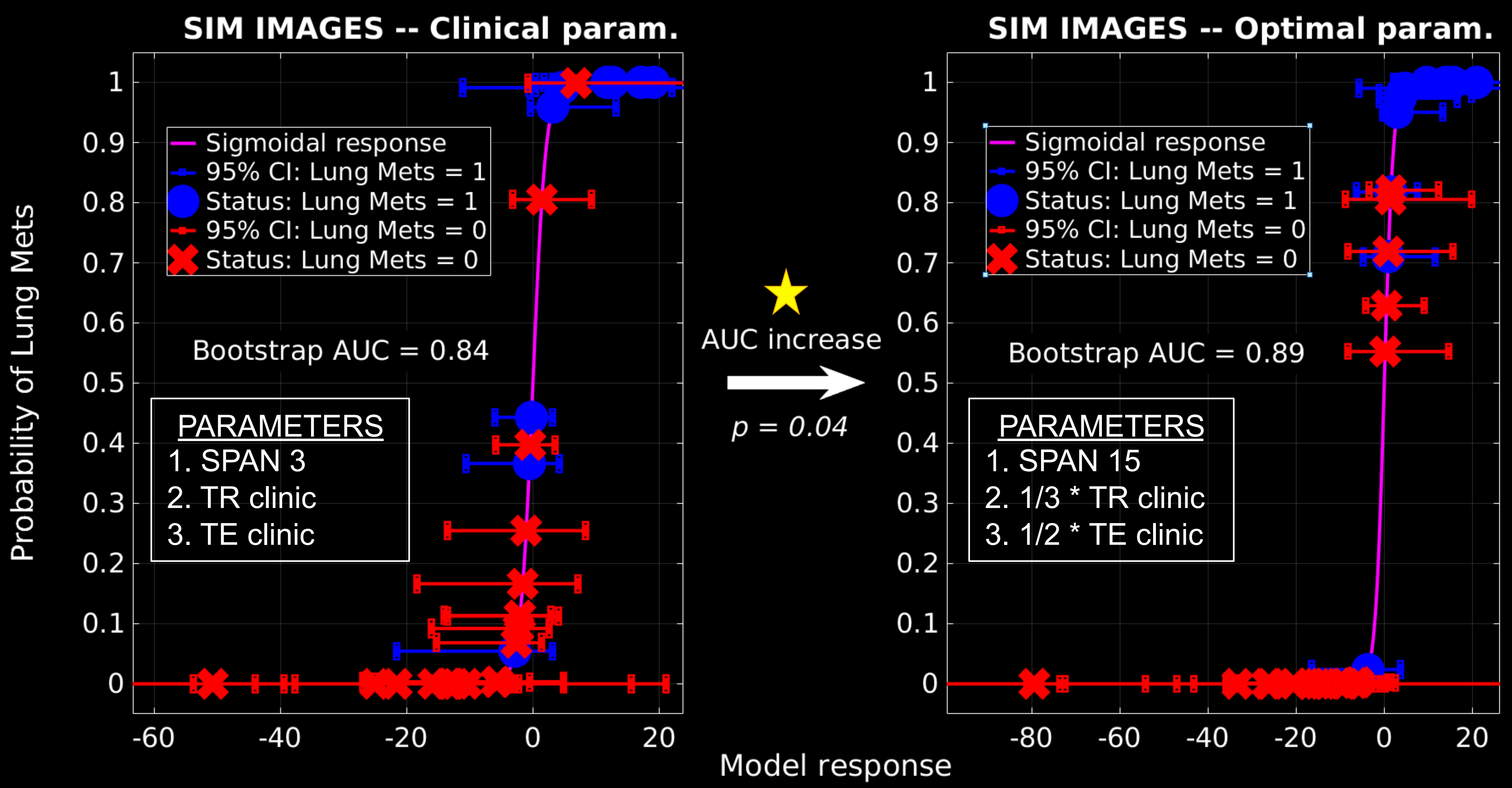
→ Model construction
- Logistic regression

→ Evaluation
- 1000 bootstrap samples

# SIMULATION OF IMAGE ACQUISITION: EXAMPLE



# TEXTURE-BASED MODEL OPTIMIZATION



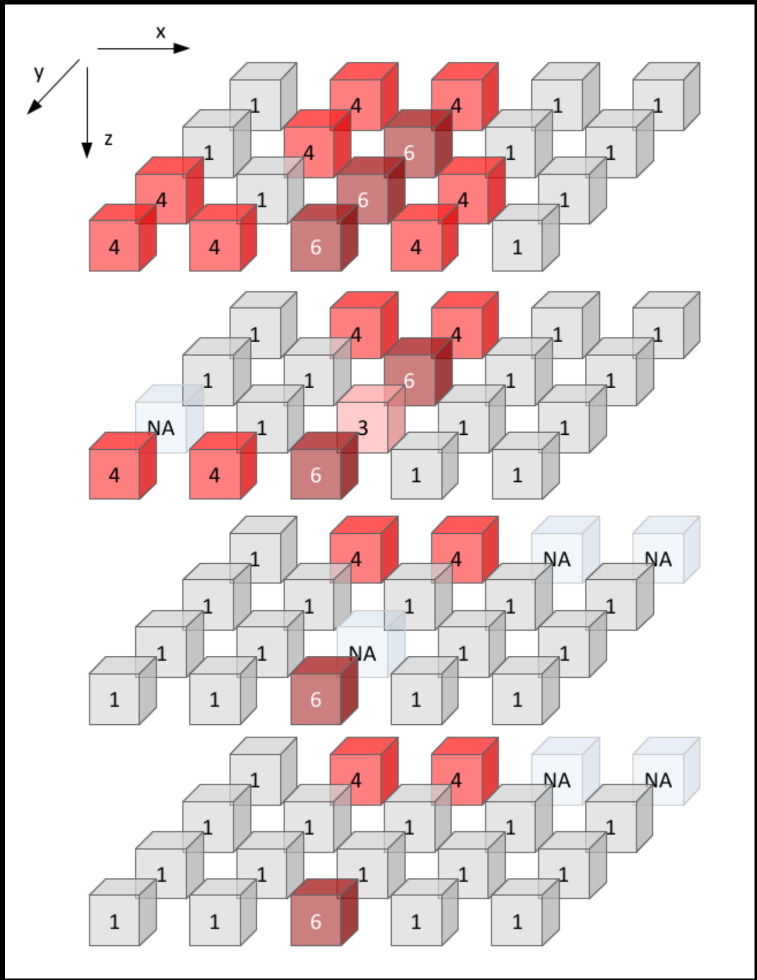

**Vallières M** *et al* 2017 *Phys. Med. Biol.* **62** 8536

# CONCLUSIONS

- Texture-based imaging models could be used to predict cancer outcomes (e.g. lung mets in STS cancer).
- Texture-based prediction models could be enhanced by optimizing FDG-PET and MR imaging acquisitions.
- Prediction performance of our texture-based model improves with:
  - Higher SPAN for PET images
  - Shorter TR for $T_1$-weighted images
  - Shorter TE for $T_2$-weighted images
- Proof-of-concept study: findings need to be verified on larger cohorts.

# STANDARDIZATION OF RADIOMICS

DIGITAL PHANTOM



- Group: 50 scientists from 18 institutions in 8 countries.
- Goal: Standardize and benchmark radiomic feature computation.
- Results: Exhaustive list of features (172) and benchmarks results available online.

Zwanenburg A, Leger S, Vallières M & Löck S. Image biomarker standardisation initiative. *arXiv* preprint, arXiv:1612.07003 (2016).