# In vivo validation of quantitative SPECT/CT imaging with Lu-177

J.C. Sanders[1,2], T. Kuwert[2], P. Ritt[2]

[1]*Pattern Recognition Lab, University of Erlangen-Nuremberg*
[2]*Clinic of Nuclear Medicine, University Hospital Erlangen*

## Goal:

Dosimetry for Lu-177 radiotherapy is often carried out using a series of planar acquisitions which improperly account for attenuation, and overlapping organs. 3D dosimetry with SPECT/CT could mitigate these shortfalls but requires a quantitative image. Our goal was to extend to Lu-177 an existing SPECT/CT quantitation protocol developed for Tc-99m and validate it *in vivo* using urine samples.

## Methods:

Our quantitation protocol requires a set of parameters to be passed to an ordered subset expectation maximization reconstruction algorithm and a calibration factor (CF) to convert reconstructed counts to kBq/mL. To determine optimal parameters, we reconstructed each of Lu-177's photopeaks (113 and 208 keV) separately for a range of iterations (it) while keeping a constant 8 subsets (ss) and applied a CF derived from a homogenous cylinder acquisition. We tracked the quantitative accuracy (QA) in the spheres and a noise measure in the background.

For *in vivo* validation, urine samples were collected following 12 SPECT/CT patient acquisitions ca. 24 hours p.i. with 6.1±0.3 GBq of Lu-177-DOTATATE, and activity concentrations were measured in a well counter to serve as a ground truth. Data was reconstructed using parameters chosen in the phantom experiment, and estimated bladder kBq/mL from the images were compared to the true values.

## Results:

In the phantom experiment, the 208 keV peak yielded less noise and superior QA, and the update level of 16it8ss was selected as the best compromise between QA and increased noise at higher iterations. For patients, the mean error of SPECT/CT concentrations was 10.1±8.3% (range: -19.4-22.4%), with a 95% confidence interval between -11.4 and 3.6%.

## Conclusion:

Our results show that quantitative Lu-177 SPECT/CT imaging of large objects is possible with current clinical technology. However, future work is needed in areas of dead time correction and automatic segmentation to make 3D dosimetry feasible for routine clinical use.