# An Introduction to Quantitative Imaging

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## Title: Basic Image Manipulation and Measurements

**Highlights:**

- An introduction to the concept of quantitative imaging with a summary of the range of parameters that can be measured with MRI.
- A practical demonstration of some simple manipulations and measurements of MRI images.

**Target audience:** Researchers and clinicians wishing to understand and implement quantitative measurements.

**Purpose:** To introduce the concept of quantitative imaging and describe how to perform simple measurements on MRI images.

**Objectives:** Following this talk, attendees should be able to:

- Appreciate the range of quantitative parameters which can be measured using MRI
- Use freely available software to:
  - Perform simple manipulations of images
  - Measure properties of images such as their signal-to-noise ratio
- Recognise the effect of random and systematic errors on the quantitative parameters calculated from MR images.

**Methods:** MRI is routinely used to produce qualitative images with different weightings, e.g. T1, T2 etc.... These provide an impressive visualisation of normal and pathological tissues; however the signal in each voxel is dependent upon a combination of factors. Important information can also be extracted from *quantitative images* – maps of the physical properties of tissues. Examples include images of longitudinal and transverse relaxation times; magnetisation transfer, flow, perfusion and diffusion parameters; magnetic susceptibilities and metabolite concentrations.

**Results:** In a simple practical demonstration the audience will be guided through a measurement of the signal-to-noise ratio (SNR) of an image. A demonstration of the impact of SNR on the fitting of quantitative parameters that decay exponentially such as $T_2$, $T_2$* etc…, will be presented.

**Discussion:** Quantitative measurements are affected by both random and systematic errors. Therefore it is crucial to determine the experimental uncertainty of a measurement and to quote it with the results of the measurement, for example $T_2$=66±5 ms. By doing so others will know the level of precision of your measurement, and hence how confident they should be that it reflects the true value of the parameter being measured.

**Conclusion:** Quantitative imaging encompasses a wide number of techniques which can provide a rich and diverse range of information about both normal and pathological tissues complementing the information gathered from qualitative images.

**Suggested Reading:**


- Paul Tofts *Quantitative MRI of the brain: measuring changes caused by disease*
- Donald W. McRobbie, Elizabeth A. Moore, Martin J. Graves, and Martin R. Prince *MRI: From Picture to Proton*