

The Image Grand Tour for Exploring Medical Images

**Jürgen Symanzik*,
Utah State University, Logan, UT &
Washington University of St. Louis, MO**

Bradley Wallet, Automated Decisions LLC

William Shannon, Washington University of St. Louis, MO

***e-mail: symanzik@math.usu.edu**

WWW: <http://www.math.usu.edu/~symanzik>

Overview

- A Motivational Example
- IGT and Grand Tour
- IGT Software
- IGT for MRI
- Discussion

A Motivational Example (1)

Based on

Symanzik et al. (2002)



A Motivational Example (2)

- Pictograph from Hueco Tanks State Historical Park (east of El Paso, TX)
 - ◆ Faded over centuries
 - ◆ Destroyed through vandalism
- Current digital enhancement techniques time-consuming
- Use of IGT: faster detection of hidden features
- Photograph provided by Robert Mark
- **IGT Pictograph Demo**

A Motivational Example (3)

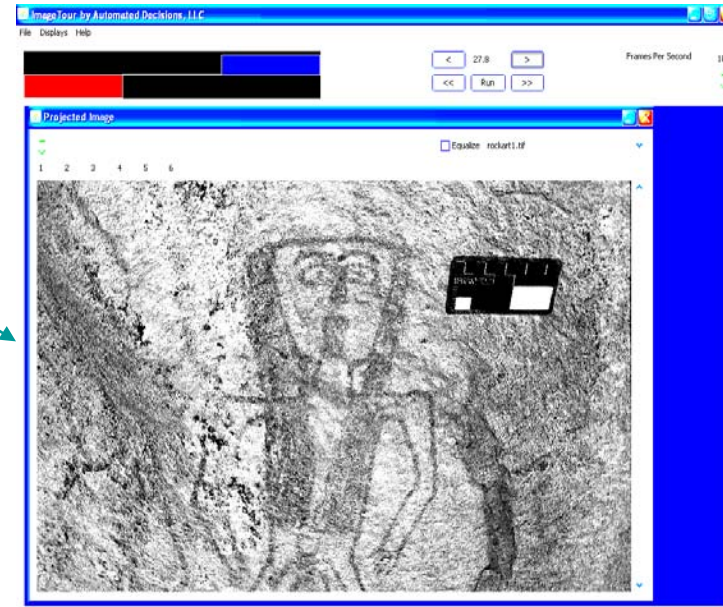
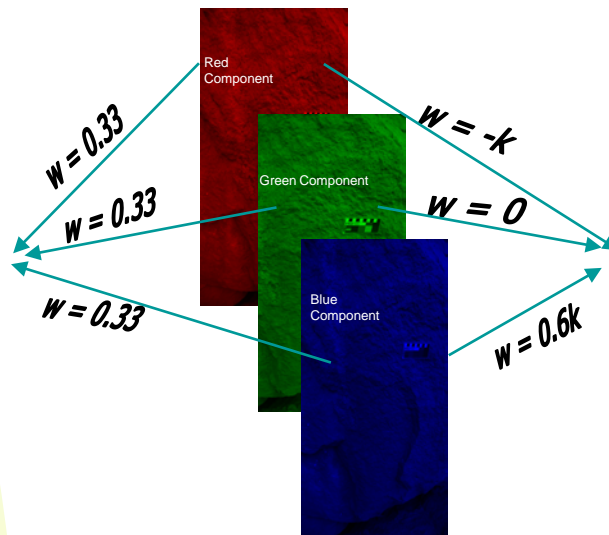


Image Grand Tour (IGT)

- A method to address:
 - ◆ Multispectral imagery
 - ◆ Satellite imagery various look angles
 - ◆ Multiple time series
 - ☞ Seismic Signals
 - ☞ Electrocardiograms: see HealthRx CardioView ECG Analysis Software by J. Patrick Vandersluis, <http://www.healthrx.com/patrick/>
- Original Developers:
Ed Wegman, Wendy Poston, Jeff Solka

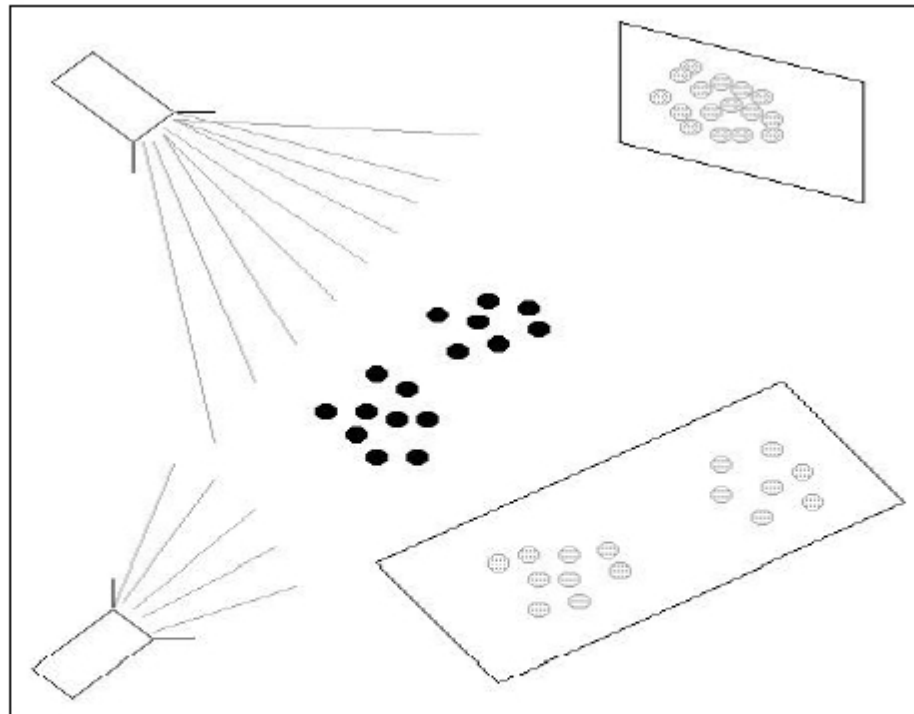
Grand Tour (1)

The Grand Tour is motivated by the idea of looking at an object from all possible points of view. From a high-dimensional data visualization point of view, we want to look at a point cloud from all perspectives.

Types of tours:

- **2-dimensional (Asimov, 1985), (Buja and Asimov, 1985)**
 - ***d*-dimensional (Wegman, 1991)**

Grand Tour (2)



This simple diagram, borrowed from Guy Nason , University of Bristol, UK (<http://www.stats.bris.ac.uk/~guy/pjg/SimplePP.html>) illustrates the principle behind projection of 3-dimensional data onto 2-dimensional surfaces. Notice that from one projection only a single cluster is visible while from another, two clusters are clearly visible

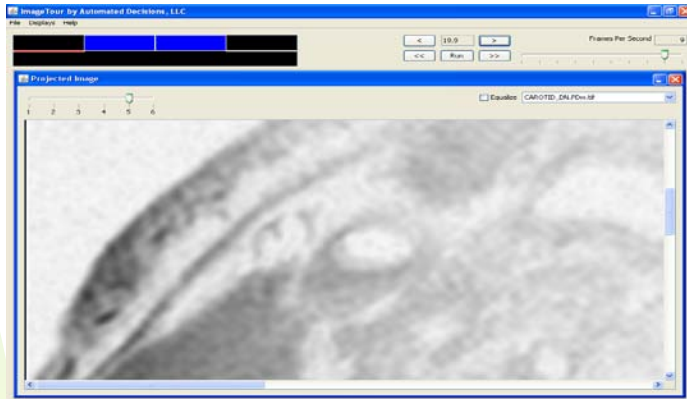
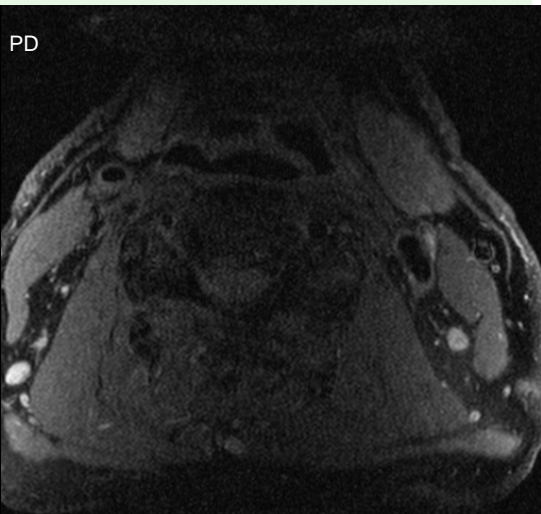
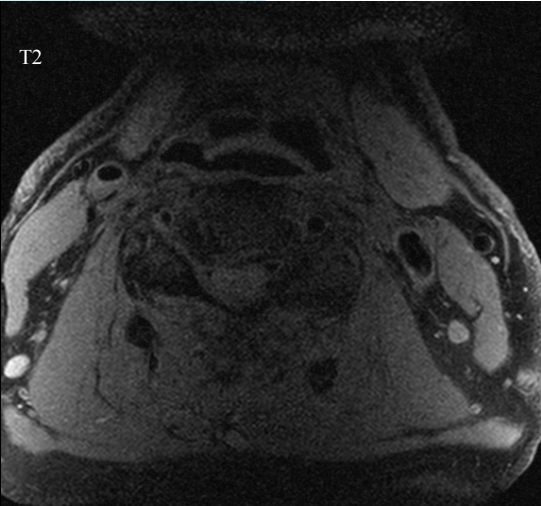
IGT Software

- Qian Luo et al.: C/C++ SGI (UNIX) implementation
- Wendy Martinez (Poston): Matlab implementation
- Amy Braverman: non-public implementation at JPL
- Brad Wallet: Java implementation (for PCs)

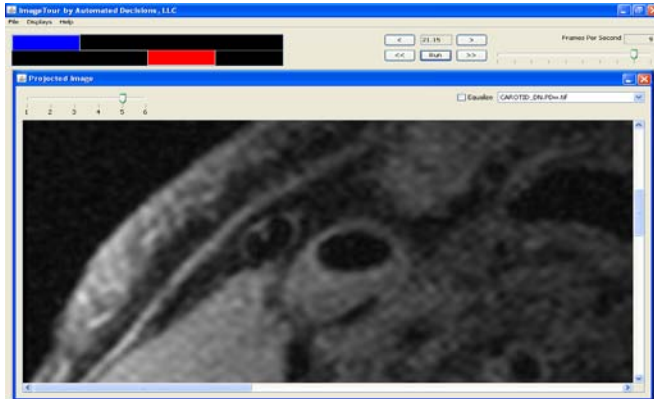
IGT for MRI (1)

- Magnetic Resonance Imaging (MRI) Scan
- First suggested by Wegman et al. (1998) – but never applied before
- Here: Mouse carotid region
- T2 and PD aligned images
- T1 not properly registered
- MRI data provided by Jie Zheng

IGT for MRI (2)



Average of T2 and PD
(Equal Weighting)



Unequal (opposite) Weighting

■ IGT MRI Demo

Discussion

- IGT useful for multiple applications
- Lots of “whoas” for MRI images
- Fast to find “interesting” features in images
- Does not produce “nice” images
- Static view and movie view of interest
- Easy to add new functionality in Java version of the IGT software
- Ultimate goal: Development of a convenient software platform and tool box for image management, image alignment, and applying the IGT to multimodality image sets.

References

- **Symanzik, J., Wegman, E. J., Braverman, A. J., Luo, Q. (2002): New Applications of the Image Grand Tour, *Computing Science and Statistics*, Vol. 34, CD.**
- **Wegman, E. J., Poston, W. L., Solka, J. L. (1998): Image Grand Tour, In: Automatic Target Recognition VIII - Proceedings of SPIE, 3371, 286-294; Republished in: Sadjadi, F. (Ed.), Vol. 6: Automatic Target Recognition. The CD-ROM, SPIE, Bellingham, WA, 1999.**