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A platform of digital brain using crowd power

Key words:
Artificial intelligence; Digital brain; Synthesis reasoning; Multi-source analogical generating; Crowd wisdom; Deducing; Neuroimaging

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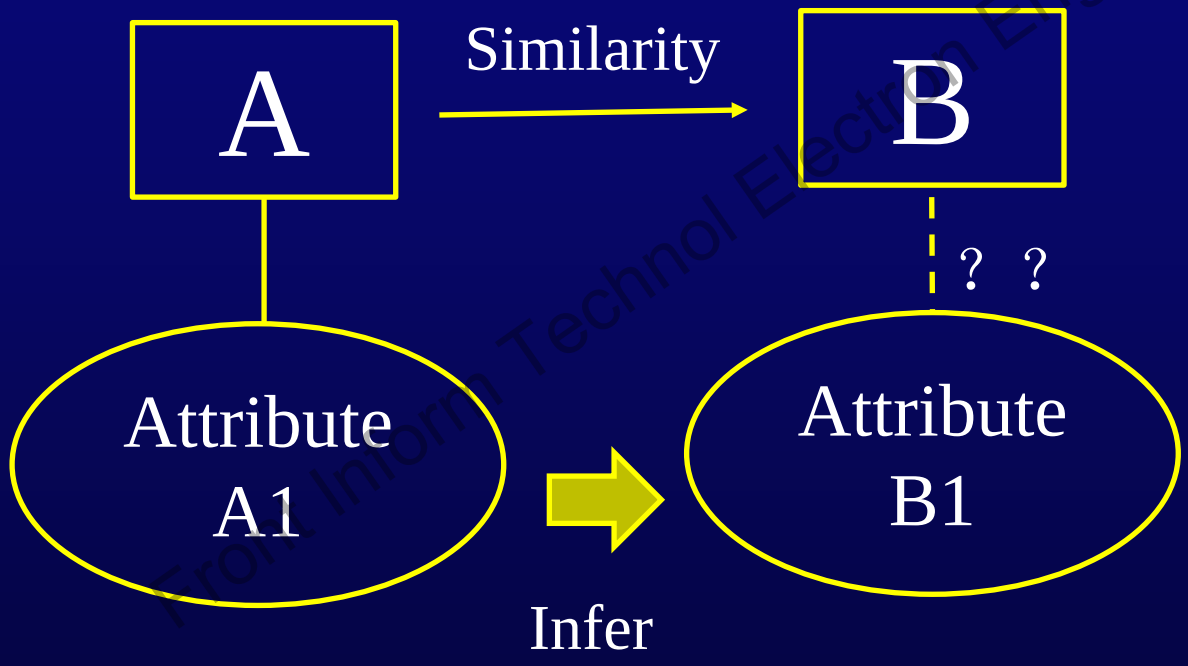
Motivation

- Use computational artificial intelligence to assistant brain research
- To develop:
  - a comprehensive brain database
  - a brain phantom generator
  - a brain knowledge base, and
  - an intelligent assistant for research on neurological and psychiatric diseases and brain development
- To demonstrate the working mechanism and effectiveness of the SR / MSAG model

Main Idea

- Use Synthesis Reasoning (SR) and Multi-Source Analogical Generating (MSAG) to model the computational platform so that various knowledge can be integrated
- Employ large number of data (big data) and crowd wisdom to build up and enhance the power of the system, thereby making it a powerful tool for brain research

Analogical Reasoning



A ~ B & A:A1 → B:B1 & B1 ~ A1

Analogical Generating

- Harrier Jump Jet
- Ultra-Sound Washing Machine
  Parents - Children

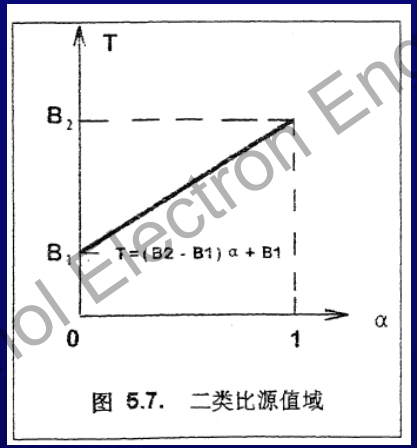


图 5.7. 二类比源值域

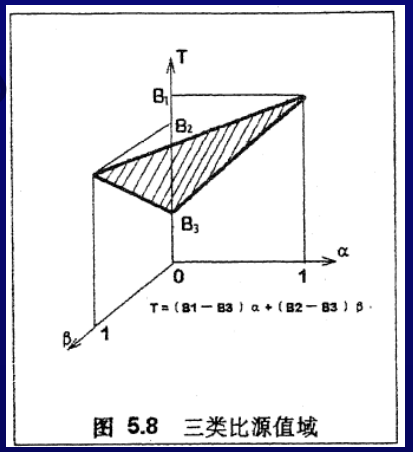


图 5.8 三类比源值域

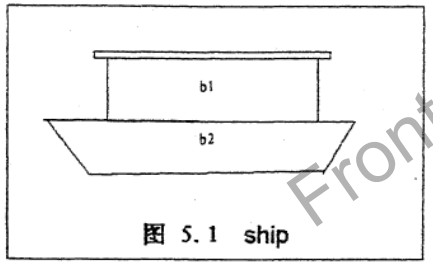


图 5.1 ship

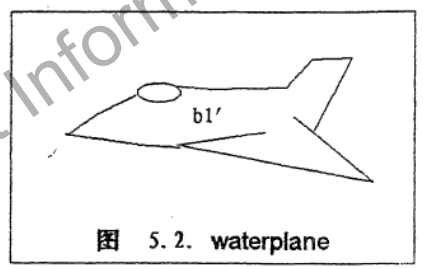


图 5.2. waterplane

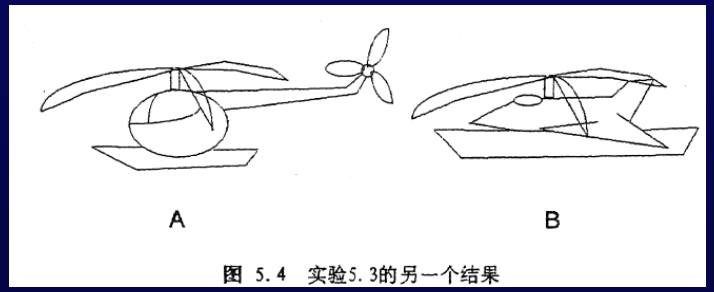
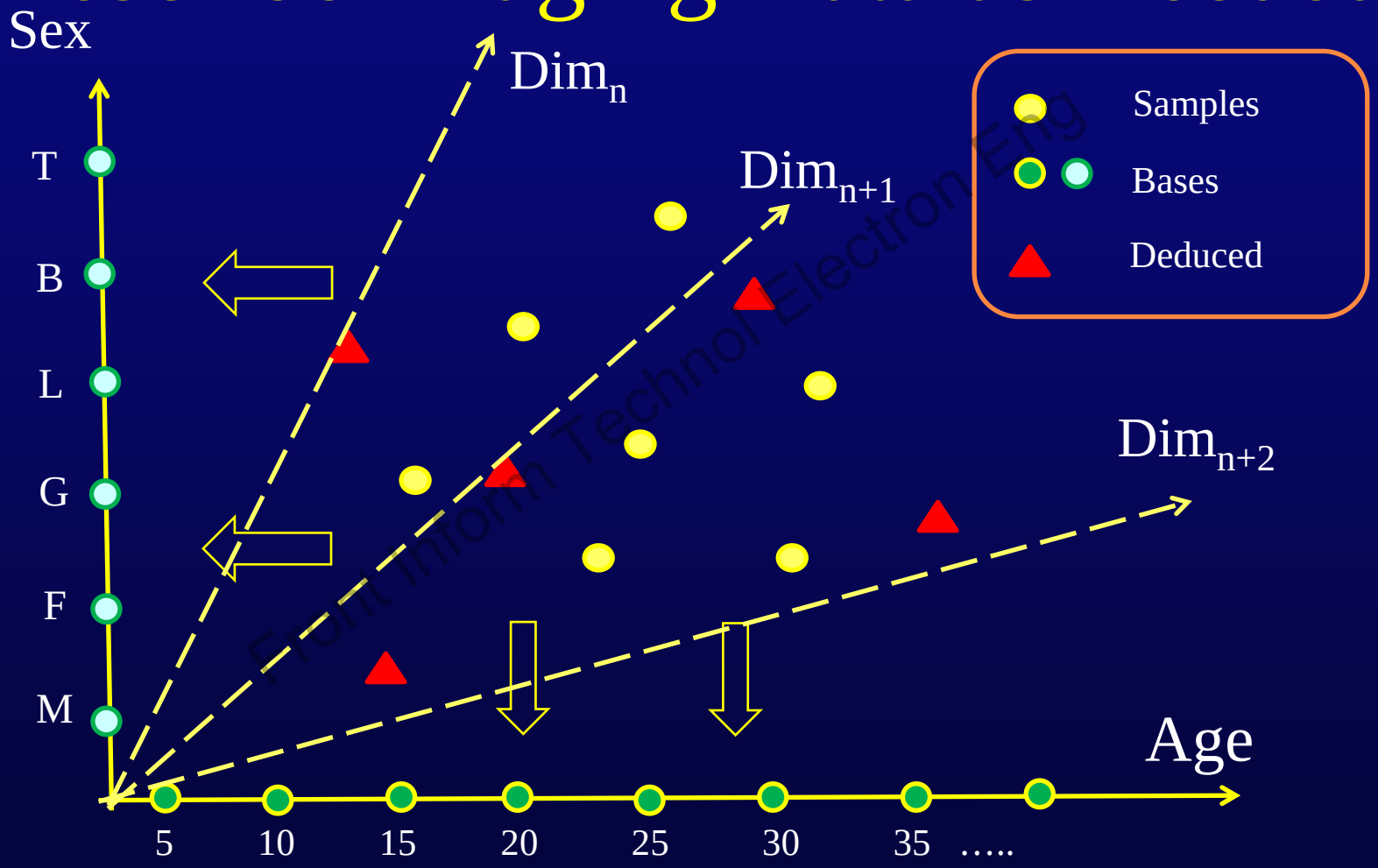


图 5.4 实验5.3的另一个结果

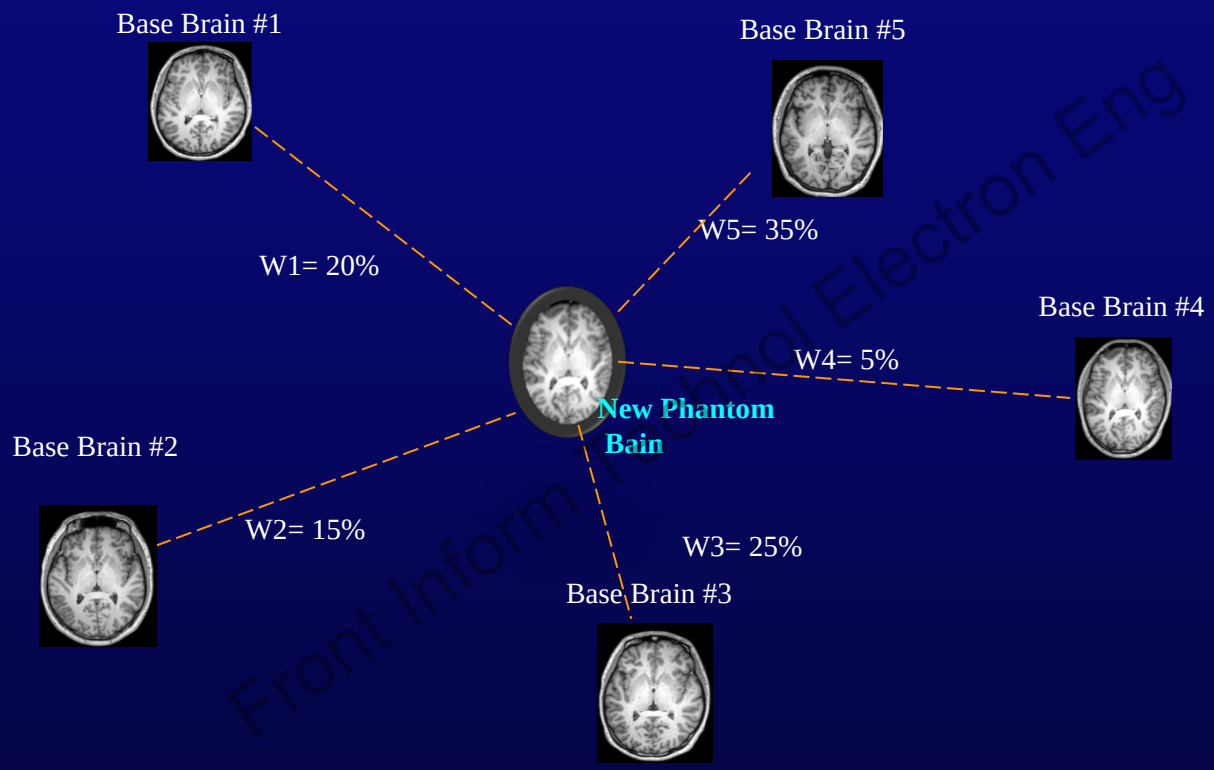
Untie Reasoning → MSAG → Synthesis Reasoning

Method:
Prescribe Imaging Data as Needed



Note: Sex is supposed to be used as a dummy variable. Here we use it as a variable just for illustration

Method: The MSAG Computational Framework for Neuroimages



Morphology
(shape, contour, cortical thickness, regional volume)
Voxel intensity
Relaxation times
Functional network
Fiber connectivity
Genetical info
EEG
Demographic info
(race, sex, age, education, social-eco status)
…..

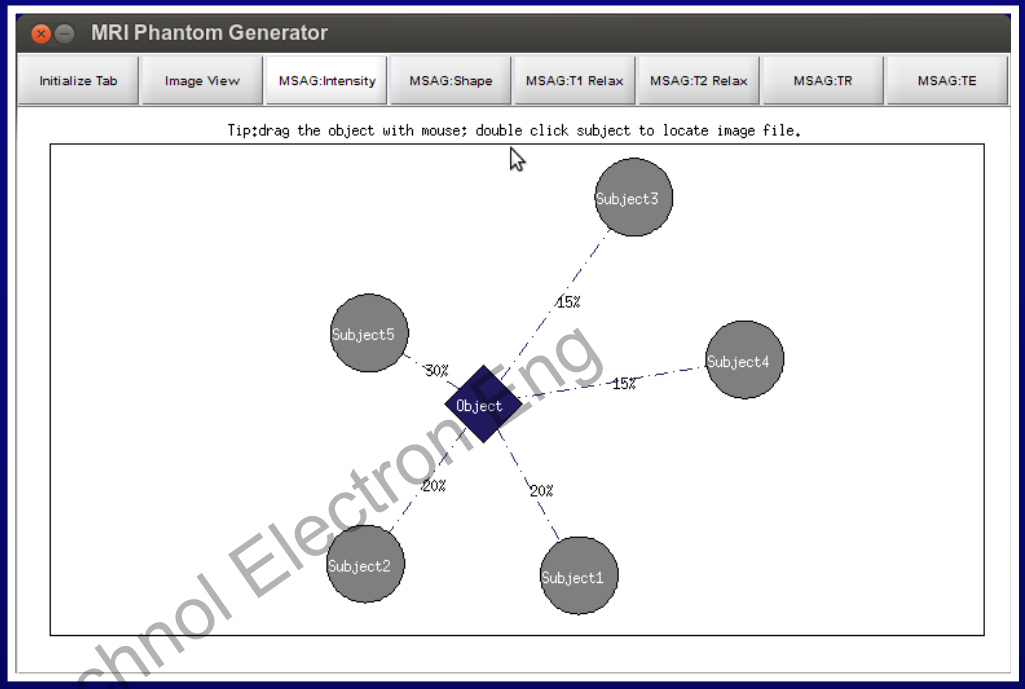
MRI / PET / CT

- Very high-dimension feature space for MSAG reasoning
- A neuroimaging phantom system, and also a comprehensive knowledge base system for brain studies

Our System

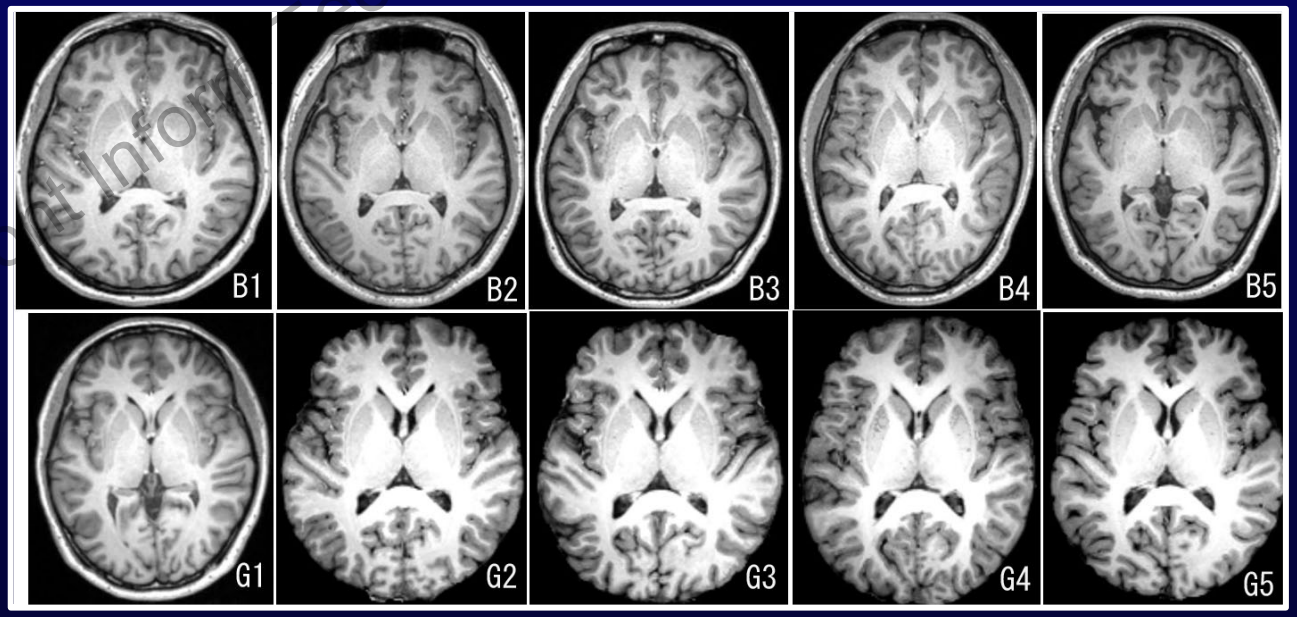
User Interface

Result -1

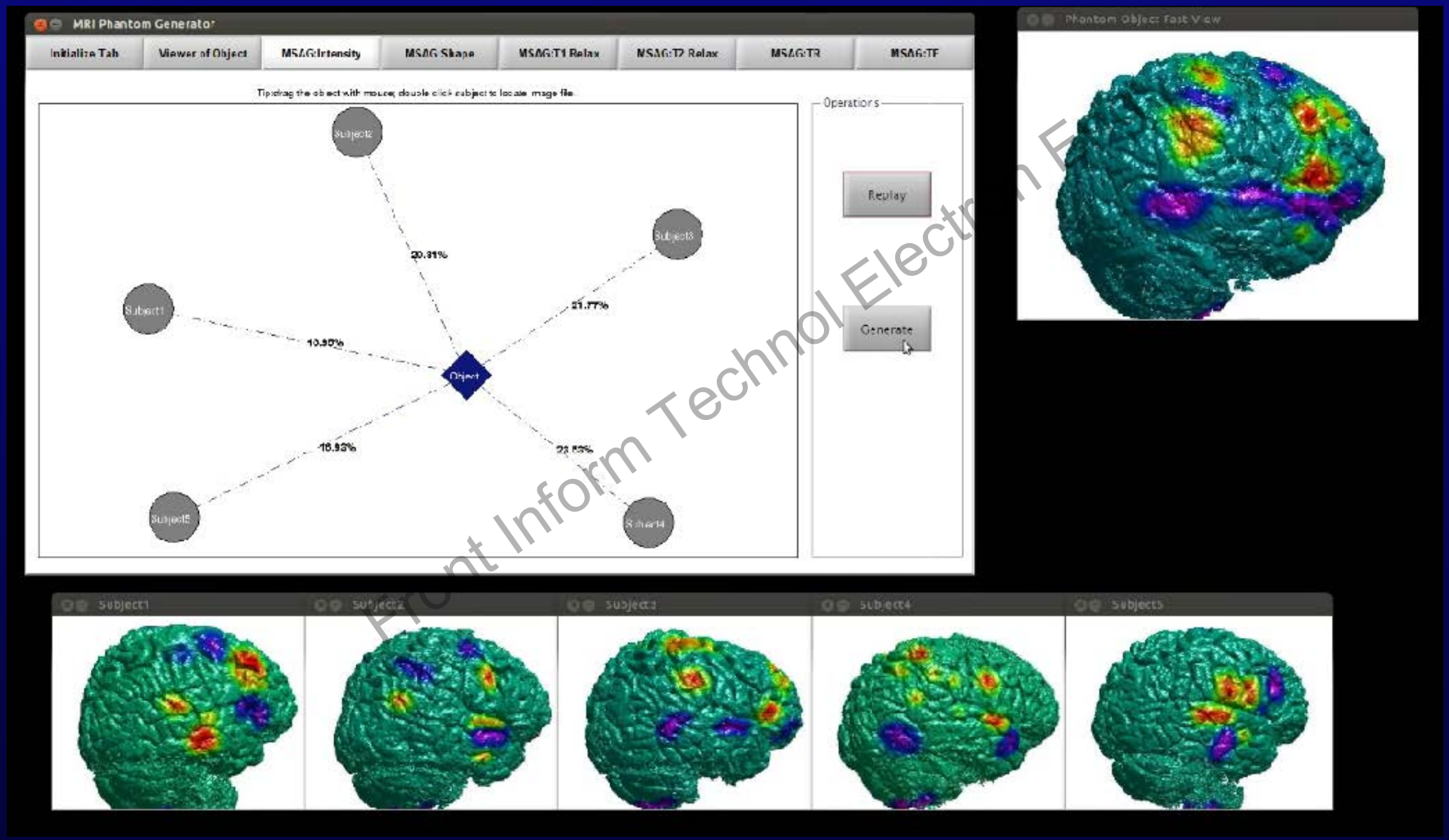


Base Brains

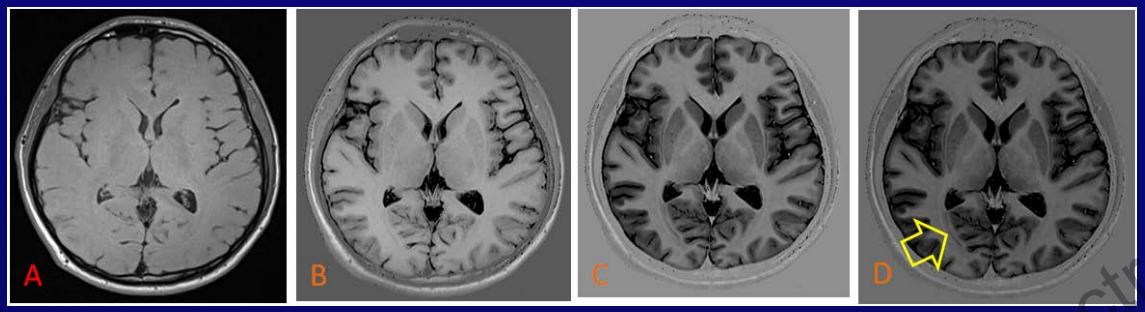
Generated Brain Images

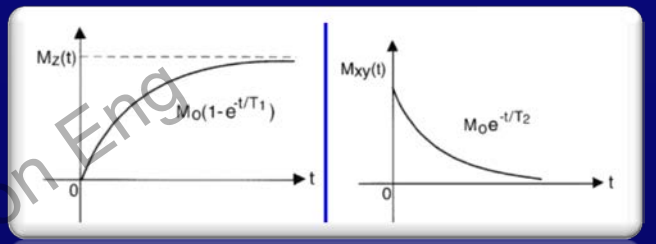


Result-2: Cortical Thickness

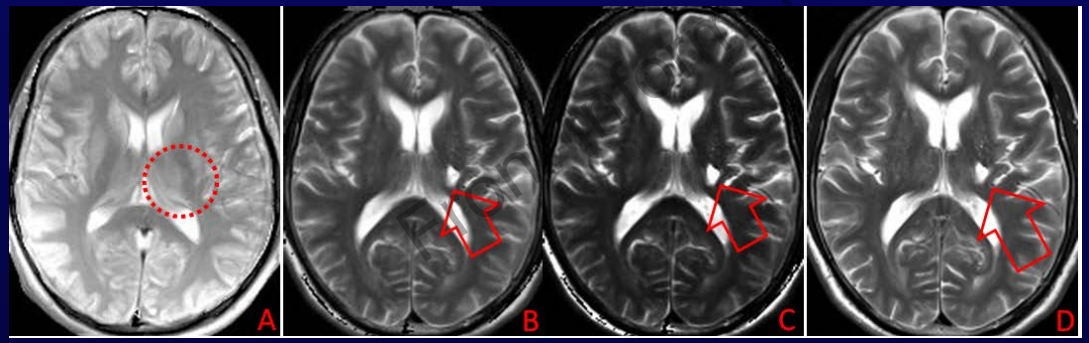


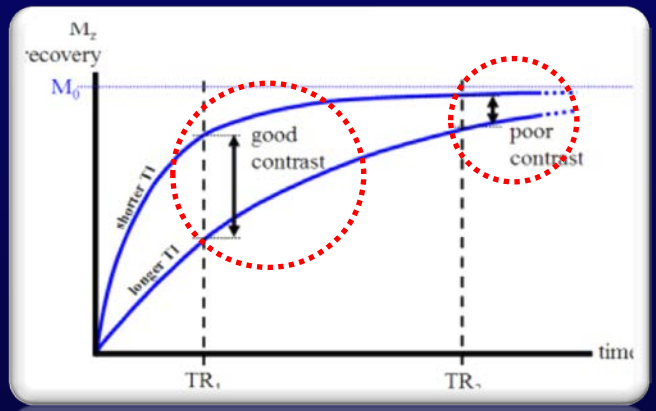
Result -3





(A) The original T1W image, the structural details barely seen. (B),(C),(D) The deduced images at different settings from the original, customized to individually highlight gray matter (B,C) and the optic radiation (D) at the yellow arrow tip, respectively.





A clinical example on stroke patient. (A)A T2w image at TR=6K ms, TE=93ms, the tumor invisible. (B)&(C) Deduced optimal results(TE = 93ms & 150ms, respectively): tumor is clearly visible. (D) An actual scan made in the range of the recommended setting(TE=93ms), very similar to our prediction (B).

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Conclusion

- SR/MSAG is a powerful and novel computation intelligence method that is different from traditional AI methods.
- We have built a powerful platform based on the SR/MSAG computational model that may derive a number of applications for brain research.
- Our work demonstrated the working mechanism of SR/MSAG, which is readily to be extended to many other applications.