The Physics of Digital Information Systems

Short Presentation May 19, 2009

Dr. Fred Cohen
President - California Sciences Institute
CEO – Fred Cohen & Associates

Why Information Physics

- A scientific approach to information protection and digital forensics is needed.
- One way to create such an approach is to have a theoretical model as a basis and a physics that works with that model to allow predictions to be made and experiments to be performed to confirm or refute the theories.
- The physics of digital information systems is an attempt to start down this path, and this short presentation is intended to act as an introduction to such a physics.

What is InfoPhysics

- Properties of digital systems
  - Like Newtonian mechanics
- At a higher level than the mathematics
  - Instead of field equations
- Summaries that apply in most cases
  - Like the quasi-static case in physics
- That are usually true – except in special cases
  - F=ma - except near the speed of light

Examples

- Digital systems have finite granularity (t and s)
  - Physical systems do not
- Digital space converges while physical space diverges.
  - Given an initial state and inputs, outputs and final state are known
  - Given final state and output, inputs and prior states are not unique
- FSMs produce partially ordered output sequences
- Limits on accuracy and precision based on representation

More examples

- Languages have different content density
  - Compression and codings alter content density
  - Hash functions and digital signatures are lossy
- Content only has meaning in context
- Computational complexity is a digital version of the "speed of light"
- Many FSMs may produce identical or nearly identical results
- Minor differences amplified near discontinuities
- Major differences suppressed far from discontinuities

Thank You

http://calsci.org/ - calsci at calsci.org

http://all.net/ - fc at all.net

Further Reading

- F. Cohen, "Digital Forensic Evidence Examination", ASP Press, 2009, ISBN#1-878109-44-8