

## PROJECTS & INTERESTS

My InterNet archive <http://www.ingber.com> contains code and reprints documenting my statements, providing my optimization and nonlinear-stochastic algorithms which have been further developed and folded into my present codes.

### **Theoretical Physics**

My original professional experiences and publications were in theoretical nuclear physics, always focused on explaining experimentally verifiable data [1-4]. I also contributed to teaching methodologies in various disciplines, including physics [5-7].

### **Adaptive Simulated Annealing (ASA) & Modelling**

My optimization code, Adaptive Simulated Annealing (ASA) [8], is used worldwide in many disciplines for global optimization and sampling. I have experience leading teams in several disciplines, developing some powerful models and algorithms for extracting signal out of noise for some classes of systems, e.g., that typically arise in such diverse fields as finance [9-13], neuroscience [14-23], and combat simulations [24,25], utilizing my ASA C-code [8,26].

### **Trading in Risk Dimensions (TRD) & Risk-Management**

Some of my previous work, mostly published, developed two-shell recursive trading systems. An inner-shell of trading indicators is adaptively fit to incoming market data. A parameterized trading-rule outer-shell uses my global optimization ASA code [8] to fit the trading system to historical data. A simple fitting algorithm, usually not requiring ASA, is used for the inner-shell fit.

I have developed a recent code, Trading in Risk Dimensions (TRD) [27,28], adding an additional risk-management middle-shell to create a three-shell recursive optimization/sampling/fitting algorithm. Portfolio-level distributions of copula-transformed multivariate distributions (with constituent markets possessing different marginal distributions in returns space) are generated by Monte Carlo samplings. ASA is used to importance-sample weightings of these markets.

TRD processes Training and Testing trading systems on historical data, and consistently interacts with RealTime trading platforms -- all at minute resolutions. Faster or slower resolutions can be developed using the present structure of TRD. The code is written in vanilla C, and runs across platforms such as XP/Cygwin, SPARC/Solaris, i386/FreeBSD, i386/NetBSD, etc. TRD can be run as an independent executable or called as a DLL.

### **Portfolio of Physiological Indicators (PPI)**

Quite general portfolios of specialized constituents also can be addressed, as described in [http://www.ingber.com/ingber\\_projects.html](http://www.ingber.com/ingber_projects.html). For example, multiple synchronous imaging data, processed with the TRD copula analysis, and using models of statistical mechanics of neocortical interactions (SMNI) [29-31], leads to a portfolio of physiological indicators (PPI) to enhance resolution of neocortical processing information [21].

### **PATHTREE, PATHINT & Options**

I have developed a full suite of options codes, which may be integrated with TRD, or used independently. In the early 1990's I developed PATHINT to evolve multivariate probability distributions, defined by general nonlinear Gaussian Markovian processes — multiplicative noise, and published applications in

several disciplines. In 2000, I created a faster algorithm PATHTREE, a binomial tree to evolve such probability distributions. PATHTREE was thoroughly tested and finally published [12]. Both PATHTREE and PATHINT have been applied to options codes, e.g., delivering full sets of Greeks based on such underlying probability distributions. Because of its speed of processing, PATHTREE has been used to fit the shape of distributions to strike data, i.e., a robust bottom-up approach to modeling dependence of strikes on volatilities.

### **Ideas by Statistical Mechanics (ISM)**

A recent paper, “Ideas by Statistical Mechanics (ISM)”, integrates previous projects to model evolution and propagation of ideas/patterns throughout populations subjected to endogenous and exogenous interactions [32-34]. This product can be used for decision support for projects ranging from diplomatic, information, military, and economic (DIME) factors of propagation/evolution of ideas, to commercial sales, trading indicators across sectors of financial markets, advertising and political campaigns, etc.

### **Real Options for Project Schedules (ROPS)**

These tools also are being applied to price complex projects as financial options with alternative schedules and strategies. PATHTREE processes real-world options, including nonlinear distributions and time-dependent starting and stopping of sub-projects, with parameters of shapes of distributions fit using ASA to optimize cost and duration of sub-projects [35].



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