(Quantum) Information Geometry in Biophysical Cybernetics:

On the Information Processing Second Law of Autoregressive Bistable Out-of-Equilibrium Souriau-Riemann-Lie Thermodynamics under a Symplectomorphic Cotangent Bundle

Maxwell Demon Information Ratchets: Parallel Control of aperiodic crystal condensation

Information Processing Second Law (IPSL) – Information is prone to pure energy convertion; An Ising spins information reservoire with higher SKS-entropy yields engine refrigeration of excess dissipative heat on Birkhoff ergodic transient sequence search. Transducers regulate the rate of heat extraction accordingly with particle tracking.

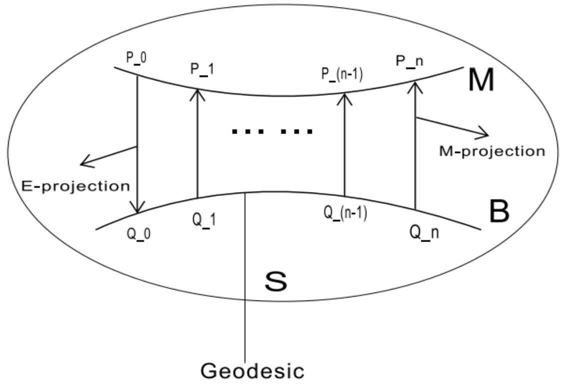
Szilard Chaotic Information Engine (Assymetric area preserving Baker DDS) ➔ In a 3 Protocol Cycle Measurment-Control-Erasure an ϵ-machine transducer synchronizes with a molecular vector field of condensed gas to regulate heat extraction. Isothermal contraction imply termal tolls on Measurment and Erasure protocols. $\int PdV = k_B T ln2$ is work extrated, compensated by Erasure.

By Frobenius-Perron operator the fractal density $\hat{p}(x',y') = \int_{\mathbb{I}^2} \delta((x',y') - \tau_C \circ \tau_M \circ \tau_E(x,y))\hat{p}(x,y)dxdy$ is the thermodynamical processing efficiency.

Geometric Algorithm of Cyberthermal retrodictive Control (Manifold Hessian curvature stability): Geodesic projection from a B-spline unstable submanifold to extrant submanifold reflecting statistical complexity distributed in a Demon unitary square dimension and ferromagnetic tape in computing a targeted density at excess entropy bound.

$$D(P \parallel Q) = \int_X f(x) log \frac{f(x)}{h(x)} dx$$

$$R^{(\alpha)}_{ijkl} = \left(\frac{\partial \log p(x;\theta)}{\partial \theta_j} \Gamma^{(\alpha)s}_{ik} - \frac{\partial \log p(x;\theta)}{\partial \theta_i} \Gamma^{(\alpha)s}_{jk} \right) g_{ik} + (\Gamma^{(\alpha)}_{jtl} \Gamma^{(\alpha)t}_{ik} - \Gamma^{(\alpha)}_{itl} \Gamma^{(\alpha)t}_{jk} \Big)$$



Autoregressive isotropic Markov Chain: Boltzmann Machine Neural Transduction

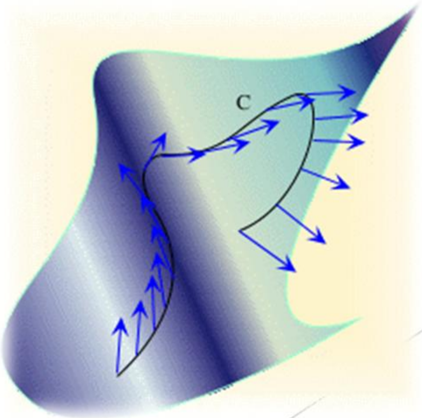
High viscoelastic transducer channeling characterizes intermediate Shannon Source Coding in ϵ-machine thermodynamical expansive control whereas output computing at the excess entropy bound maximizes statistical entropy (***infomax)*** ➔ strong evidence in enzyme chains.

Autonomous nervous system as a symmetric crystal harmonic lattice of transducers ➔ Considering the Fiducial Geodesic in a control (metabolic) protocol then for modular degrees of freedom (kernel marginality) it holds $inf_{p^{(v)}, v \in V} \mathcal{D}(p \parallel \bigotimes_{v \in V} p^{(v)})$ interpolated to a **Gauss-Markov random field** with control parameter $\beta = k_B T^{-1}$ ➔ Thermal costs of processing in non-difractional channel is minimized in data compression, for instance in a Galois prism.

For a closed Riemann-Markov differentiable submanifold exponential families a duality between learning Boltzmann Machines and sample data is more exact. The figure depicts **polar duality** in a simplex Haussdorf interior.

$$g_{ij} = \int \frac{\partial \log p(x;\theta)}{\partial \theta^i} \frac{\partial \log p(x;\theta)}{\partial \theta^j} p(x;\theta) dx,$$

$$\Gamma^{(\alpha)}_{ijk} = E\left[(\partial_i \partial_j l(x;\theta))(\partial_k l(x;\theta))\right] + \frac{1-\alpha}{2} E\left[(\partial_i l(x;\theta))(\partial_j l(x;\theta))(\partial_k l(x;\theta))\right],$$

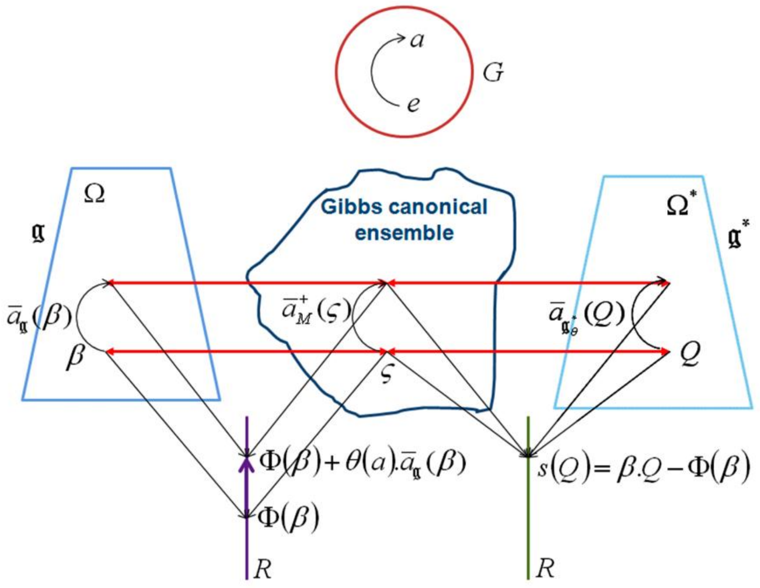


Symplectic Geometrization of Ergodic Excess Heat in Lie Cocyclic Souriau Thermodynamics

Chaotic transduction was demonstrated in a DDS ratchet control protocol to yield excess heat in Shannon sequencing entailing a **calorific capacity** for Fiducial geodesic projection protocols.

A Riemann-Souriaun metric on nondegenerate 2-form symplectic manifolds (Hamiltonian mechanics) under Lie group cocycle preserves $\frac{\partial^2 logZ\Omega}{\partial\beta^2}$ w.r.t to an affine predual Lie algebra given the equivalence with Massieu potential. The metric of dual algebra is extracted from $\frac{\partial^2 S(Q)}{\partial Q^2}$, entails the excess heat capacity of transience.

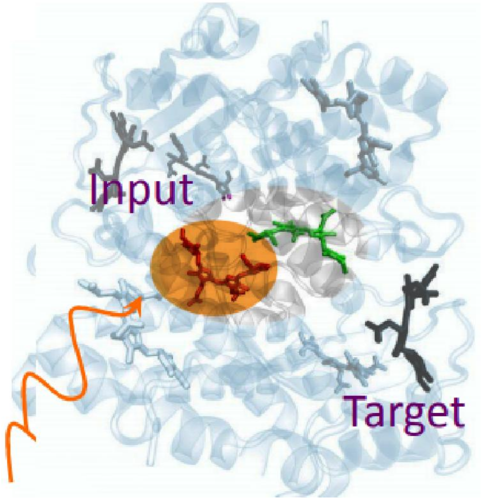
Note: Assuming isotropy, maximum entropy density Cramer-Rao estimators are derived: $logL(\boldsymbol{\theta};\boldsymbol{X}^{(t)}) = -\frac{n}{2}log2\pi\sigma^2 - \frac{1}{2\sigma^2}\sum_{i=1}^{n}\left[x_i - \mu - \beta\sum_{j\epsilon\Pi}(x_j - \mu)\right]^2$ convexity is controlled by $\frac{\partial^2 logZ\Omega}{\partial\beta^2} = \int_{\boldsymbol{X}} \frac{\partial logL(\boldsymbol{\theta};\boldsymbol{X}^{(t)})}{\partial\boldsymbol{\theta}^\mu} L(\boldsymbol{\theta};\boldsymbol{X}^{(t)})d\boldsymbol{X}$ and defines a likelihood covariant gradient invariant under Hermicity. Suppose further a closed toroidal manifold $\overline{\mathcal{M}}$ locally Euclidean affine, constant curvature, boundary polytope singularities then for efficient ratchet protocols Levi-Civita connections on the tangent space are local minimizers of C^∞a.l.p curves.

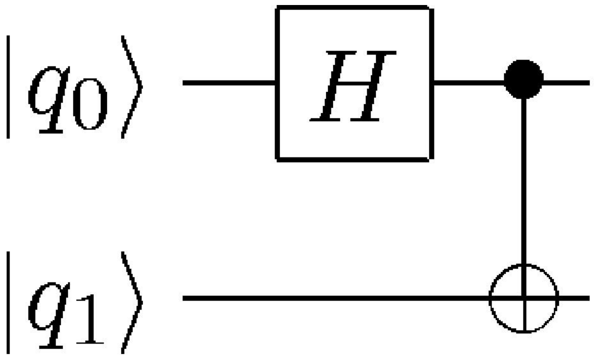


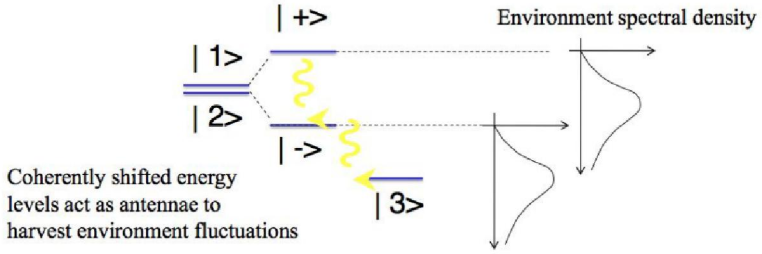
Quantum Biology: Ginzburg-Landau conductive bistability of dipole-dipole percolation under high thermal noise

Beyond exergonic quantum effects are possible in high temperatures in dynamical systems driven far from equilibirum (Zero effect); Macroscopic quantum expression is determined by aperiodic crystallization in nucleic acid sequencing acted by dipole-dipole paths.

For a Chauchy complete commutative Banach-Riesz harmonic lattice, **Ginzburg-Landau conductivity** encapsulates cubic damped Entropic Dynamics without potential ➔ $\mathcal{L}(t) = \int_0^1 dt_1 \sqrt{\int p(x,t_1)^{-1}[\frac{\partial_p(x,t_1)}{dt_1}]^2}$ **information lenght** is assymetric w.r.t phase transition from order-to-disorder and disorder-to-order, with the latter contracting molecular eigenvector permutations – Recall the maximum entropy principle in the motor phase of a control ring.







Future Research Directions

1 – Information Geometry in Norden-Sen and Eguchi geometries; non-Haussdorf topological spaces and construct information geometrical models with Teichmuller algebraic geometry (arithmetic deformations on elliptic curves).

2 –Tonegawa Immune System regulation ➔ Arrival Anisotropic Stochastic Processes

3 - Boltzmann Machine Neural Networks.

4 - Quantum computational realizations in biology.