Hybrid Bayesian Optimisation / Evolution Strategy applied to the design of uni-axially driven ICF targets

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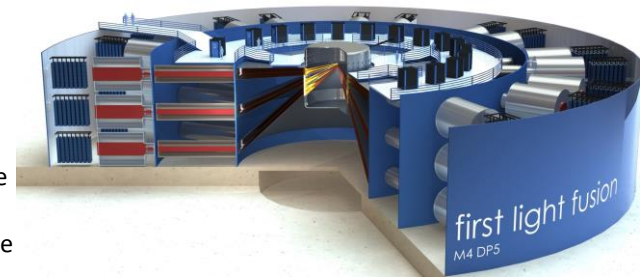

Motivations

- Seek to robustly maximise neutron yield of ICF target driven to implode by hyper-velocity projectile

- Optimising target design (shock amplifier & fuel capsule) using rad-hydro simulations and the whole system (pulsed power launcher, projectile, target) using reduced physics models

- Need to find global optimum in a parameter space of ~10 dimensions where the optimisation metric (ignition robustness) is noisy and discontinuous

Results

- Hybrid scheme combines BO (Bayesian Optimisation) for finding global optimum with CMA-ES (Covariance Matrix Adaptation Evolution Strategy) for fast convergence on local optimum

- Fault-tolerant, asynchronous batching, out-performs both BO and CMA-ES for number of evals

Challenges

- Ignition metric is noisy and has ~20 constraints built into it, making it complicated for ML approaches. However, we have had success using BO by using a data-learned transform on the objective

9D Target Design Optimisation