ETH zürich

CSElab
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Collegium Helveticum

Korali

a High-Performance Multi-Intrusive Bayesian Inference Software for Large-Scale Scientific Models

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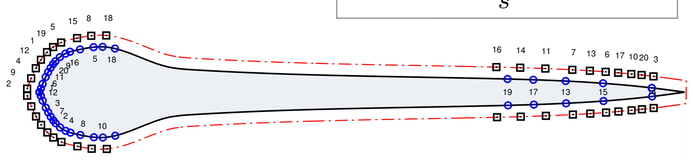
Motivation

- Optimal Sensor Placement

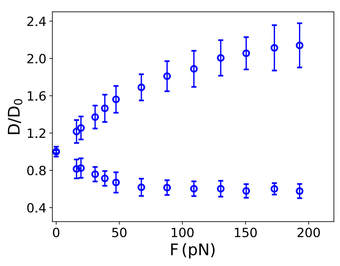
$$s^\star = \underset{s}{\operatorname{argmax}}\ \hat{U}(s)$$

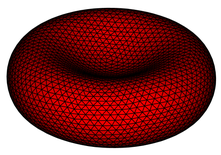
$$U(s) = \int_{\mathcal{Y}} \int_{\mathcal{R}} \log \frac{p(\boldsymbol{y}|\boldsymbol{r},\boldsymbol{s})}{p(\boldsymbol{y}|\boldsymbol{s})}\, p(\boldsymbol{r})\, p(\boldsymbol{y}|\boldsymbol{r},\boldsymbol{s})\, \mathrm{d}\boldsymbol{r}\, \mathrm{d}\boldsymbol{y}$$

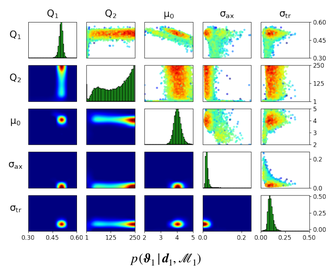


- Bayesian Inference

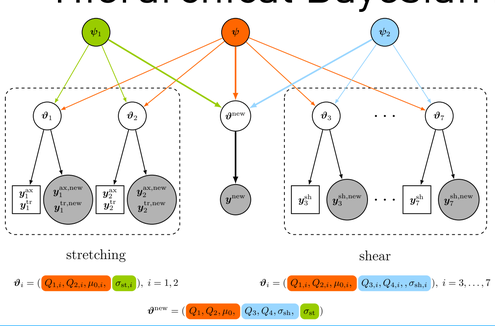
$$p(\vartheta \mid d) = \frac{p(d \mid \vartheta)\, p(\vartheta)}{p(d)}$$

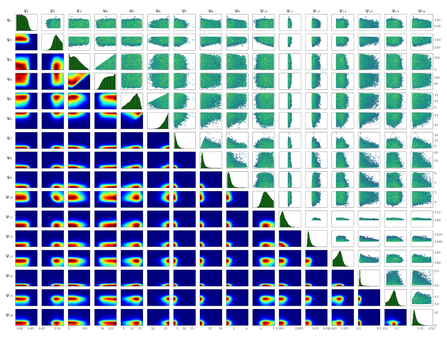






- Hierarchical Bayesian Infernce

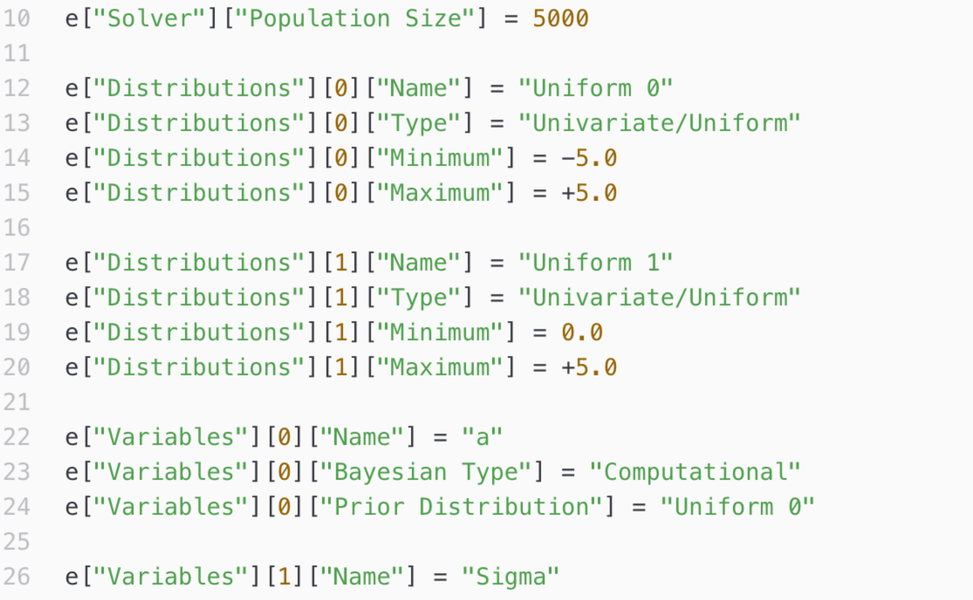




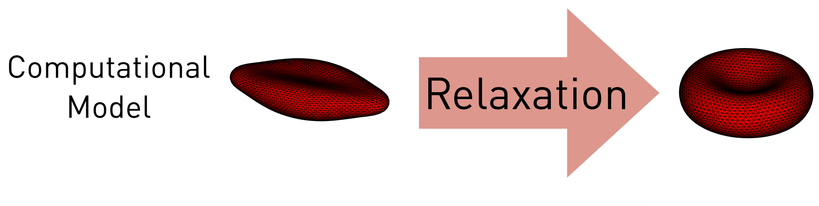
Ease of Use

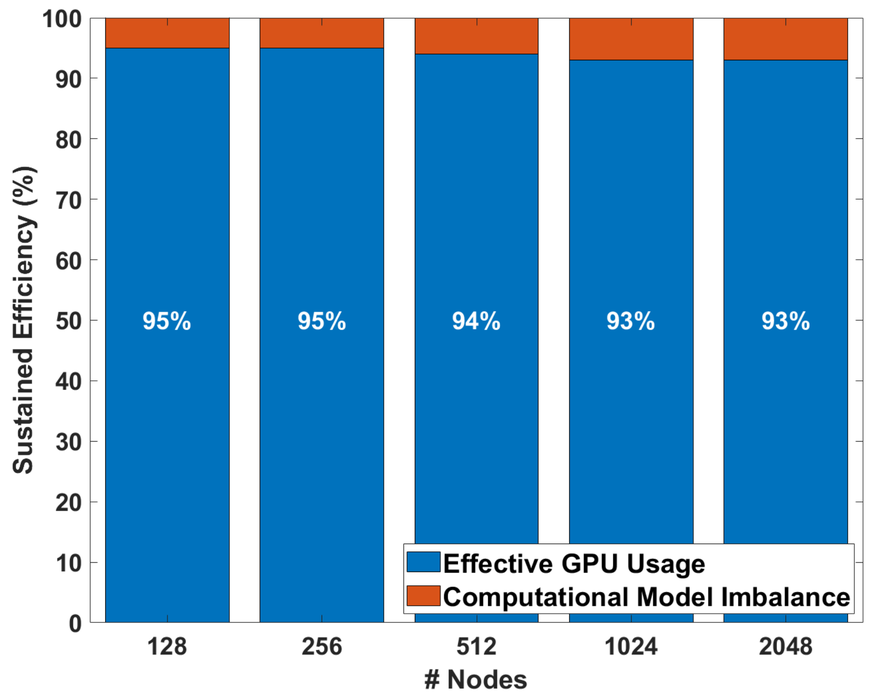
```python
import korali
e = korali.Experiment()

e["Problem"]["Type"] = "Evaluation/Bayesian/Inference/Reference"
e["Problem"]["Likelihood Model"] = "Additive Normal"
e["Problem"]["Reference Data"] = getReferenceData()
e["Problem"]["Computational Model"] = computationalModel()

e["Solver"]["Type"] = "Sampler/TMCMC"
e["Solver"]["Population Size"] = 5000

e["Distributions"][0]["Name"] = "Uniform 0"
e["Distributions"][0]["Type"] = "Univariate/Uniform"
e["Distributions"][0]["Minimum"] = -5.0
e["Distributions"][0]["Maximum"] = +5.0

e["Distributions"][1]["Name"] = "Uniform 1"
e["Distributions"][1]["Type"] = "Univariate/Uniform"
e["Distributions"][1]["Minimum"] = 0.0
e["Distributions"][1]["Maximum"] = +5.0

e["Variables"][0]["Name"] = "a"
e["Variables"][0]["Bayesian Type"] = "Computational"
e["Variables"][0]["Prior Distribution"] = "Uniform 0"

e["Variables"][1]["Name"] = "Sigma"
e["Variables"][1]["Bayesian Type"] = "Statistical"
e["Variables"][1]["Prior Distribution"] = "Uniform 1"

k = korali.Engine()
k.run(e)
```

Extensible

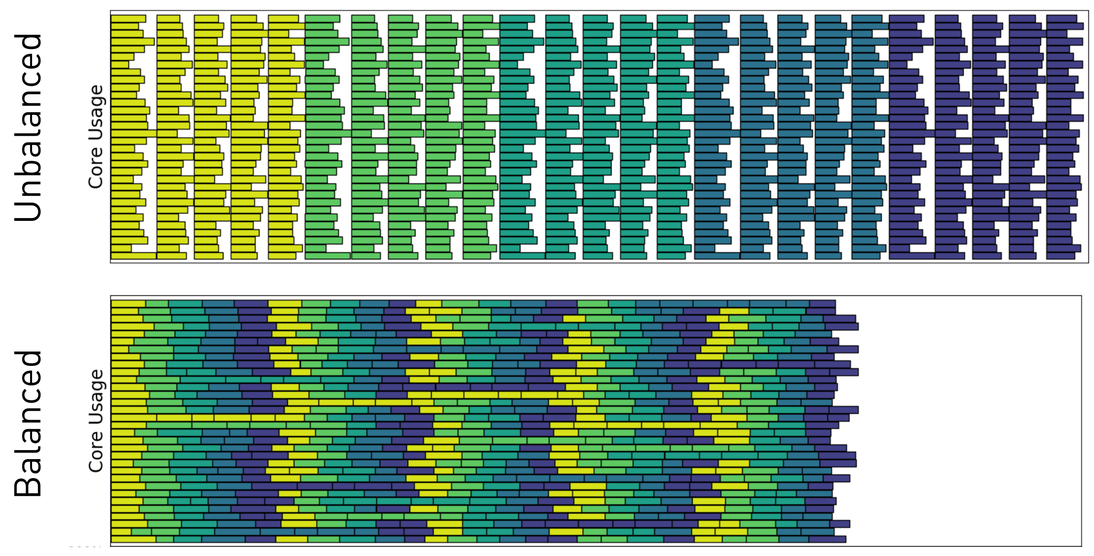


Scalable

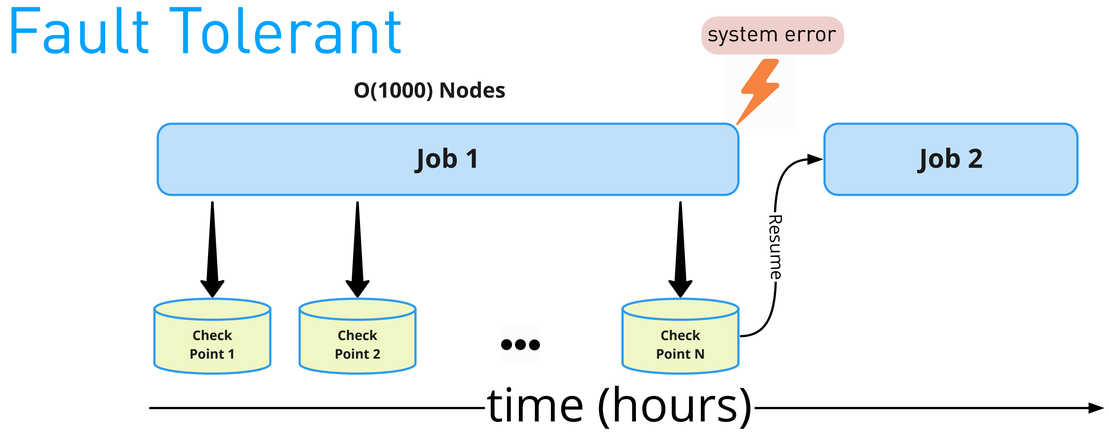




Load Balance



Fault Tolerant



Workflow