VIENNA UNIVERSITY OF TECHNOLOGY

192.137 HEURISTIC OPTIMIZATION TECHNIQUES

TU WIEN ALGORITHMICS AND COMPLEXITY GROUP

Programming Project 2

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Contents

To Do's

- either make framework work or create new framework
- analyze locks in lecture slides and in paper:
-
  - Test-and-Set Lock
  - Test-and-Test-and-Set Lock
  - Ticket Lock
  - Array Lock
  - CLH Lock
  - MCS Lock
  - Hemlock (from paper..)
- in the lectureslides from the project it says:
-
  - Benchmark the following two under various scenarious, meaning low/high contention
  - Benchmark Throughput (probably locks-unlocks performed per time)
  - Benchmark Latency
  - Benchmark for fairness, we have to think of some number to measure fairness, maybe locks/unlocks achieved per thread

1 Introduction

Proof. *let* $X \in [C^{0,1}(\bar{\Omega})]^2$ *with* $X|_{\Gamma_\infty} = 0$ *be a given vectorfield.*
Set $\mathrm{T}_t(.) := \mathrm{id} + tX$ *, with* $t \in \mathbb{R}$ *and* $\Omega_t := \mathrm{T}_t(\Omega)$*, where* $(\mathbf{u}_t, p_t)$ *solve this and* Ω *is replaced by* Ω_t *s.t.* $p_t \in \mathrm{L}^2(\Omega_t)$, $\int_{\Omega_t} p_t \,\mathrm{dx} = 0$ *and* $\mathrm{u}_t \in [H^1(\Omega_t)]^2$*. Then there holds*

$$\int_{\Omega_t} \mathrm{D}\mathbf{u}_t : \mathrm{D}\mathbf{v} + \mathrm{div}(\mathbf{v})\, p_t + \mathrm{div}(\mathbf{u}_t)\, q\, dx = 0 \quad \forall (v, q) \in [H_0^1(\Omega_t)]^d \times L^2(\Omega_t). \tag{1}$$

Introduction of change of variables shows that $(\mathbf{u}^t, p^t) := (\mathbf{u}_t \circ \mathrm{T}_t, p_t \circ \mathrm{T}_t)$ *satisfy*

$$\begin{gathered}\int_\Omega \det(\mathrm{DT}_t) \left(\mathrm{DT}_t^{-1}\mathrm{D}\mathbf{u}^t : \mathrm{DT}_t^{-1}\mathrm{D}\mathbf{v} - p\,\mathrm{tr}(\mathrm{D}\mathbf{v}\mathrm{DT}_t^{-1}) + q\,\mathrm{tr}(\mathrm{D}\mathbf{u}\mathrm{DT}_t^{-1})\right) \mathrm{dx}, \\ \forall (v, q) \in [H^1(\Omega)]^2 \times L^2(\Omega),\end{gathered} \tag{2}$$

Used in equation (2)

$$\begin{aligned}\mathrm{D}\mathbf{v} \circ \mathrm{T}_t &= \mathrm{D}(\mathbf{v} \circ \mathrm{T}_t), \\ \mathrm{div}(\mathbf{v}) &= \mathrm{tr}\left(\mathrm{D}(\mathbf{v} \circ \mathrm{T}_t)(\mathrm{DT}_t^{-1})\right).\end{aligned}$$

The functional $J(\Omega, \mathbf{u})$ *is now reduced to the functional* $J(\Omega)$*, since the change of the quantities* $(\mathbf{u}, p)$ *is taken into account by the transformation theorem. The minimum of (**??**) satisfies the saddlepoint problem . It can be obtained with the Lagrange Multiplier method, see Faustmann . The corresponding Lagrangian which can be used to minimize is*

$$\begin{aligned}\mathcal{L}(t, \mathbf{v}, q) = \frac{1}{2}\int_\Omega &\det(\mathrm{DT}_t)\mathrm{D}\mathbf{v}(\mathrm{DT}_t)^{-1} : \mathrm{D}\mathbf{v}(\mathrm{DT}_t)^{-1}\,\mathrm{dx}, \\ &- \int_\Omega \det(\mathrm{DT}_t) q\,\mathrm{tr}\left(\mathrm{D}\mathbf{v}(\mathrm{DT}_t)^{-1}\right).\end{aligned} \tag{3}$$

To find the shape derivative, one can now derive this parametrized Lagrangian, for details on the derivation of parametrized Lagrangians, see K. Ito et. al. . With the derivative of the Lagrangian obtained, it holds true that

$$\mathrm{d}J(\Omega)(X) = \frac{\mathrm{d}}{\mathrm{d}t}\mathcal{L}(t, \mathbf{u}^t, 0)\big|_{t=0} = \frac{\partial}{\partial t}\mathcal{L}(0, \mathbf{u}, p) = \int_\Omega \mathrm{S}_1 : \mathrm{D}X\,\mathrm{dx}. \tag{4}$$

$\square$

2 Generic Chapter Title 2

Here we will see the text from Iris and of the Manul. This should compile on its own now.

3 Generic Chapter Title 3