Week 6 - Complementarity Problems (Kenny)

Theory: Definition of linear complementarity problems, connection to quadratic programming problems, and splitting methods.

Literature:

Kenny Erleben: Lecture notes, unpublished, 2009, In total 29 pages.

Supplementary Material: K. G. Murty, Linear Complementarity, Linear and Nonlinear Programming, Helderman-Verlag, 1988. Section 1.1 and section 1.3 (pp. 1-9 and pp. 11-40)

Exercises: All exercises in notes by Kenny Erleben

Programming Case: A new case-study of 2D Balls in a Box simulation is to be used in this programming case. The task is that one should compute non-penetration forces given a configuration of 2D frictionless balls packed in a box only under influence of gravity.

- Download the new Matlab framework from the Absalon homepage
- Locate the matlab file named ``solve_lcp.m'' and finalize the implementation of the solve_lcp function.
- Implement a splitting method for solving the LCP problem. Here is a rough pseudo-code illustration, you may want to explain in your report why the suggested residual and error measures make sense.

```
While not converged
  lambda = max(0, -inv( L+D)*(U*lambda + b)
  residual = min(A*lambda+b,lambda)
  error    = residual'*residual
  ...
end
```

- Try to analyze the convergence rate of the implemented LCP solver
- Derive the Splitting method in your report, argument why it finds a solution to the LCP
- Show algebraic how the LCP is equivalent to a QP
- Show an animation strip in your report of the motion computed by the resulting simulator.
- Show your matlab implementation in an Appendix.
- For the students with extra time at their hands:
  - Try to describe how the simulation loop in the matlab framework works.
  - Try and implement a QP solver for the LCP problem, compare the performance of the QP solver with the LCP solver