Some Constrained Simulations

• Constraints for cloth representation

↓

Large steps in cloth simulation (1998)
• force-based implicit solver

↓

A versatile and Robust Model
for Geometrically Complex
Deformable Solids (2004)
• generalized constrained dynamics

Verlet's integration
('60)

↓

Advanced Character Phisics (2001)
• Position-based method

↓

←————— force-based

position-based →

Position Based
Dynamics (2006)

the field of
Geometric Optimization
• manifold projection method

Example-Based
Elastic Materials (2011)
• minimization
formulation

Shape-Up: Shaping Discrete
Geometry with Projections (2012)
• block coordinate descent method
(local / global solver)

PBD (2006)
• Constraints
• Position-based solver

Fast Simulation of Mass-Spring
System (2013)
• local / global physics solver

Distributed optimization
and statistical learning
via the Alternating
direction method of
Multipliers (2011)
• ADMM

Projective dyn. (2014)
• Jacobi-type local /global solver
• Constraint projection
• Continuum dynamics-based constraints

ADMM ⊇ Projective dynamics (2016)
• generic method that supports arbitrary
conservative force (non-linear
elastic materials
• hard constraints
e.t.c.)

PBD
. Position based method

Geometric, Variational Integrators for Computer Animation (2006)
. Symplectic method

Efficient Simulation of Inextensible Cloth (2007)
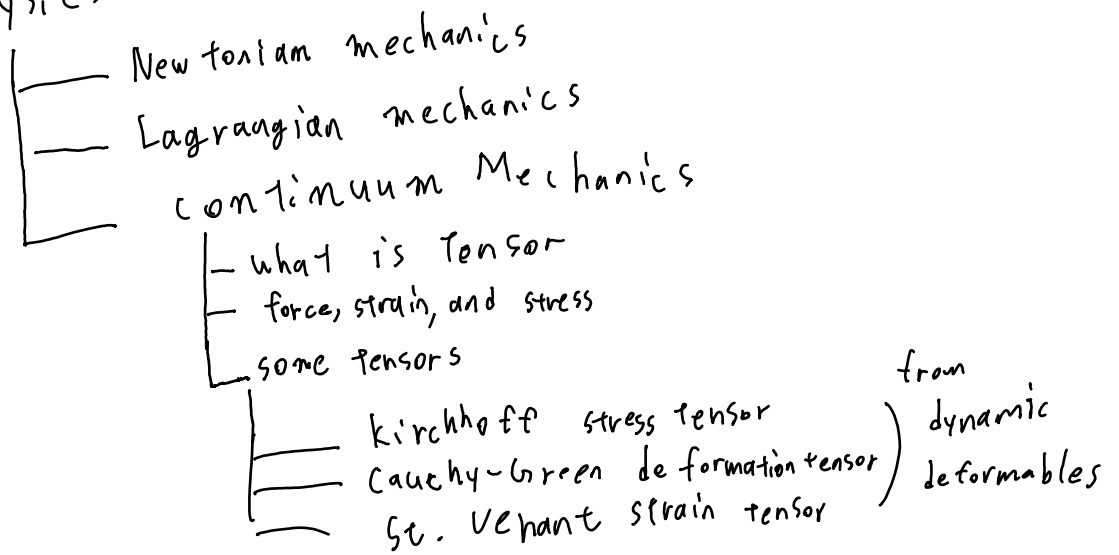. fast projection

Interactive Simulation of Elastic Deformable Materials (2006)
. constraints with the phisically-based parameters
. compliant constraint formulation

Strain based Dynamics (2014)
. The constraints from strain tensor
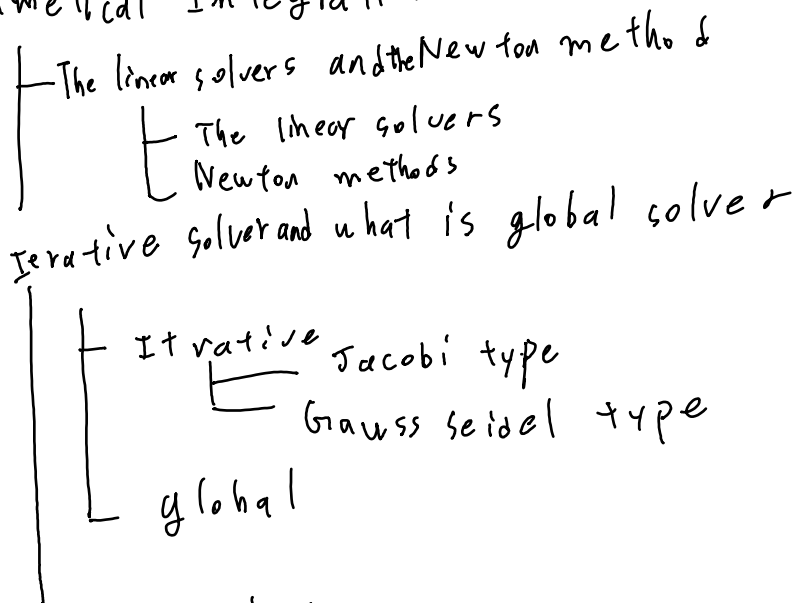. Decoupling stretch from shear resistance

XPBD has an advantage against to strain based Dyn.

X PBD (2017)
. Physicall-based constraints
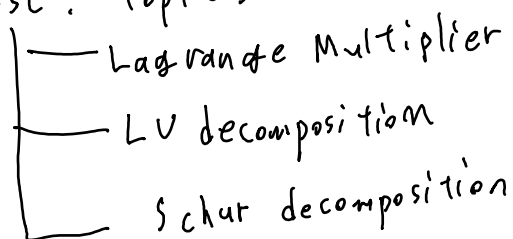. total Lagrange multiplier ← (This formulation resolves the iteration dependency)

- Physics
  - Newtonian mechanics
  - Lagrangian mechanics
  - Continuum Mechanics
    - what is Tensor
    - force, strain, and stress
    - some tensors
      - kirchhoff stress tensor   ) from
      - Cauehy-Green deformation tensor   ) dynamic
      - St. Vehant strain tensor   ) deformables

- Numelical Integration
  - The linear solvers and the Newton method
    - The linear solvers
    - Newton methods
  - Ierative solver and what is global solver
    - Itrative Jacobi type
      - Gauss Seidel type
    - global
  - misc. topics
    - Lagrange Multiplier
    - LU decomposition
    - Schur decomposition

- Numerical physics
  - mass - spring system
  - Verlet's integration
  - Explicit / Implicit euler scheme
  - constrained Dynamics
  - shape matching

- Interpret the papers
  - Position Based Dynamics
    - Large steps in Cloth Simulation (1998)
    - Advanced Character Physics (2001)
    - A versetile and Robust Model for Geometrically complex Deformable solids (2004)
    - Position Based Dynamics (2006)
  - XPBD
    - Geometric, Variational Integrators for Computer Animation (2006)
    - Interactive simulation of Elastic Deformable Materials (2006)
    - Efficient Simulation of Inextensible Cloth (2007)
    - XPBD (2017)
    - Small steps in Physics simulation (2018)
  - Projective Dynamics

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- Projective Dynamics
  - Example-Based Elastic Materials (2011)
  - Fast simulation of Mass-Spring System (2013)
  - Projective Dynamics
  - ADMM $\supseteq$ Projective Dynamics
- Post XPBD