01/16/07 Other textbooks:

Øksendal, Stochastic Differential Equations

- pure math

Karatzas + Shreve, Brownian Motion + Stochastic Calculus

- really technical + thorough

Gard, Stochastic Differential Equations

- decent intermediate mathematical treatment

Examples:

1) Population Models:

$$\frac{dX}{dt} = aX(K - X)$$

Logistic equation

X = population

a = growth constant

K = carrying capacity

t = time

Uncertain: Immigration (add noise)

Environmental ~~[illegible]~~ Variations:

random flucs in a, K

Similar ideas for Lotka-Volterra models

SIS epidemics for interacting populations

2) Molecular dynamics

mass matrix

$$\vec{M} \frac{d\vec{X}}{dt} = \vec{p}$$

$$\frac{d\vec{p}}{dt} = -\vec{\nabla} V(\vec{X})$$

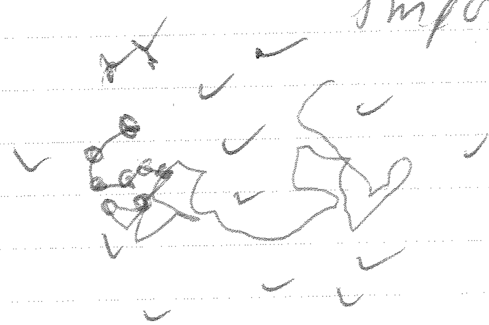
potential energy

$\vec{X}$ = positions of atoms

$\vec{p}$ = momenta

supervectors

Large biomolecules: water molecules important



T. Schlick, Molecular Modeling

[illegible]

Coarse-grain the molecule or solute, and the effects of water on microscale.

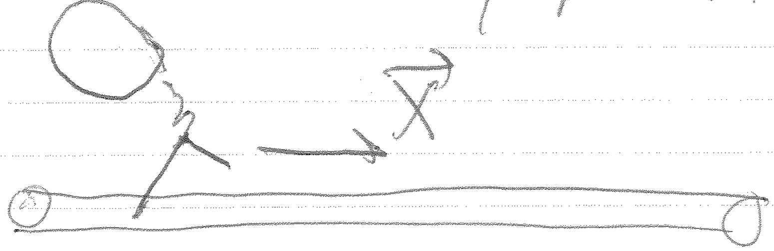
On large enough scales (microns), water's main effect might be hydrodynamic

$$\overline{M}\,\frac{d\vec{X}}{dt} = \vec{p}$$

friction matrix

$$\frac{d\vec{p}}{dt} = -\vec{\nabla}\,\overline{V}(\vec{X}) \underbrace{-\,\Gamma(\vec{X})\,\vec{p}}_{\text{dissipation from coupling to fluid}} \underbrace{+\,F_T(\vec{X},t)}_{\text{stochastic thermal forcing}}$$

3) Molecular motors / Brownian motors



$$\underbrace{\gamma}_{\text{friction coef}} \frac{d\vec{X}}{dt} = -\vec{\nabla} V(\vec{X}(t), f(t)) + y(t)$$

+ thermal noise

$\vec{X}$: molecular motor position

$f(t)$, $y(t)$: random inputs that modulate the potential