Title: Special Topics in Astrophysics - Numerical Hydrodynamics - Lecture 22

Speakers: Daniel Siegel

Collection: Special Topics in Astrophysics - Numerical Hydrodynamics

Date: December 01, 2020 - 3:30 PM

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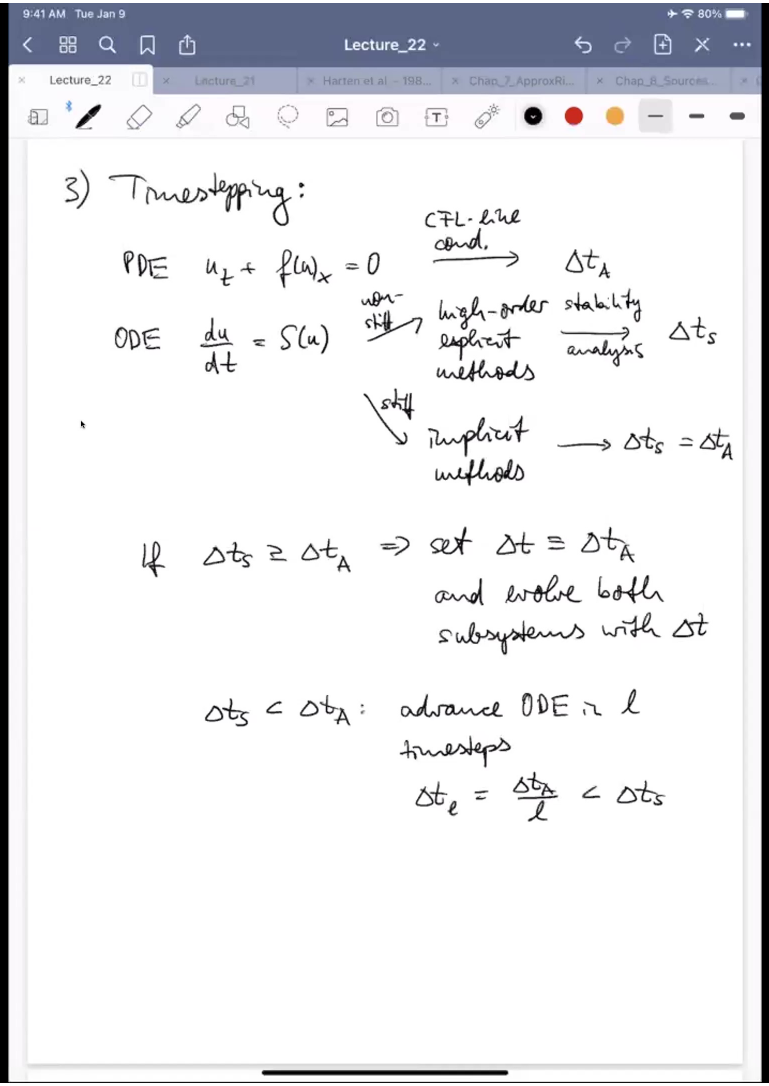
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Lecture_22
Lecture_21
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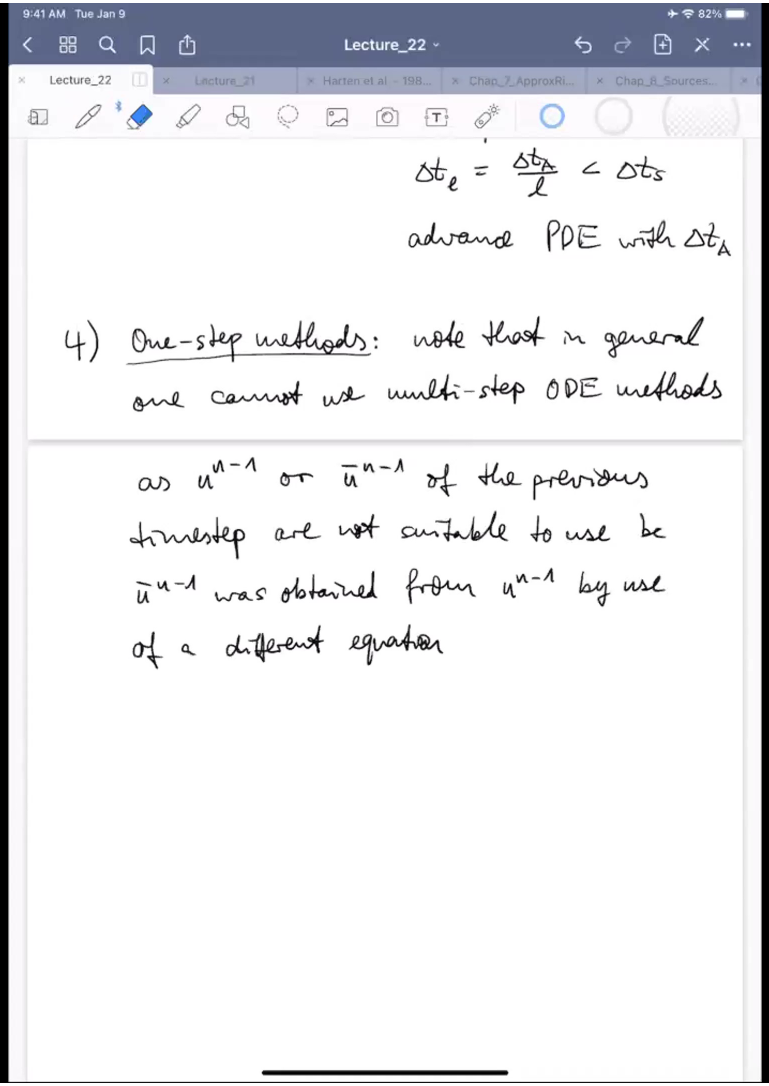
Chap_8_Sources...
3) Timestepping:
PDE $u_t + f(u)_x = 0$
CFL-like cond.
Δt_A
ODE $\frac{du}{dt} = S(u)$
non-stiff
high-order explicit methods
stability analysis
Δt_S
stiff
implicit methods
$\Delta t_S = \Delta t_A$
if $\Delta t_S \geq \Delta t_A$ $\Rightarrow$ set $\Delta t = \Delta t_A$ and evolve both subsystems with Δt
$\Delta t_S < \Delta t_A$: advance ODE in l timesteps
$\Delta t_l = \frac{\Delta t_A}{l} < \Delta t_S$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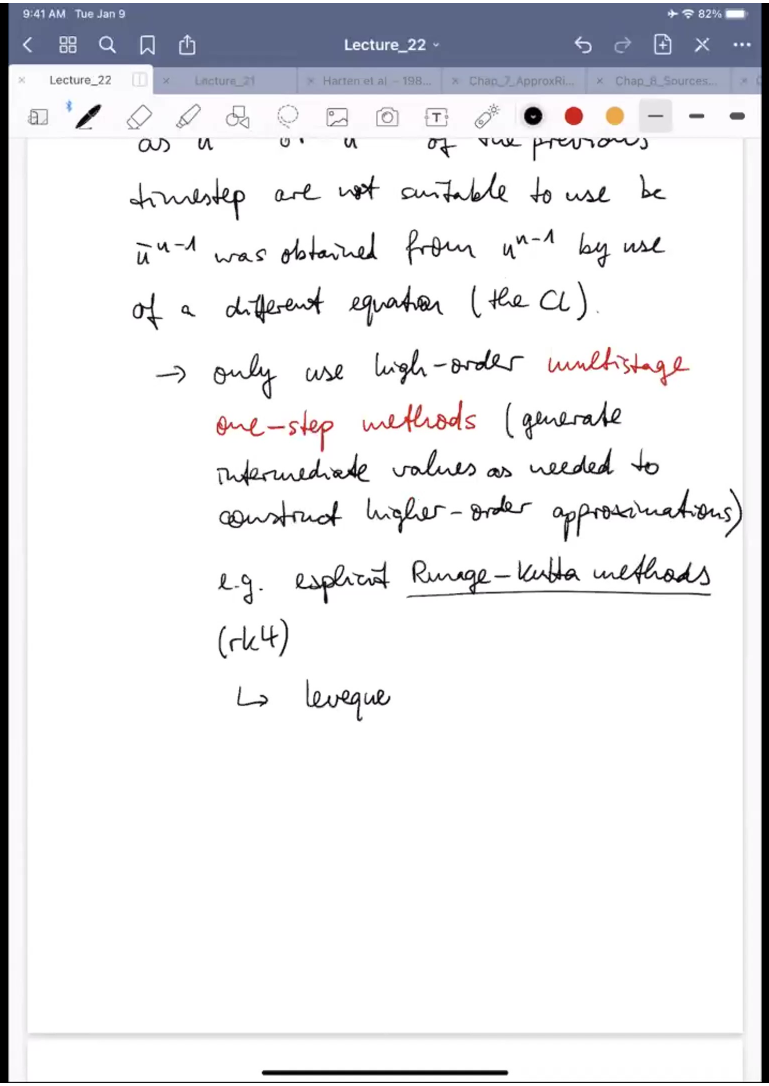
$\Delta t_e = \frac{\Delta t_A}{l} < \Delta t_s$
advance PDE with Δt_A
4) One-step methods: note that in general one cannot use multi-step ODE methods
as u^{n-1} or $\bar{u}^{n-1}$ of the previous timestep are not suitable to use bc $\bar{u}^{n-1}$ was obtained from u^{n-1} by use of a different equation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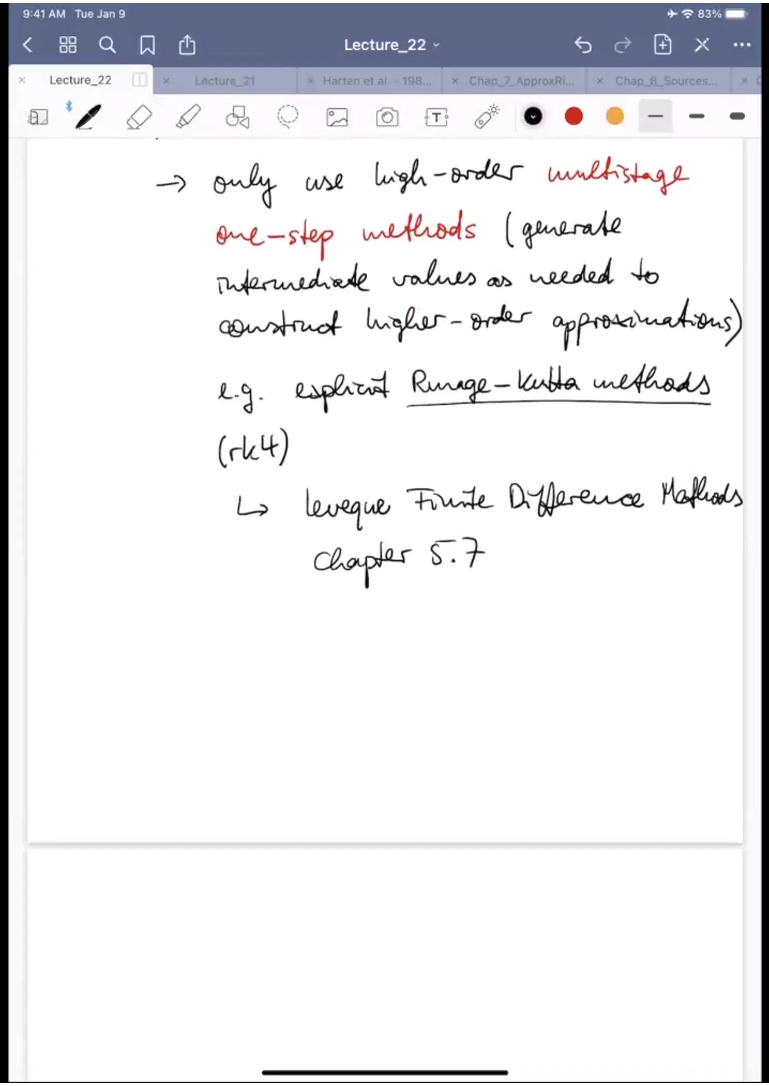
as u^{n-1} of the previous
timestep are not suitable to use bc
$\bar{u}^{n-1}$ was obtained from u^{n-1} by use
of a different equation (the CL).
→ only use high-order multistage
one-step methods (generate
intermediate values as needed to
construct higher-order approximations)
e.g. explicit Runge-Kutta methods
(rk4)
↳ leveque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→ only use high-order multistage one-step methods (generate intermediate values as needed to construct higher-order approximations)
e.g. explicit Runge-Kutta methods (rk4)
↳ leveque Finite Difference Methods chapter 5.7