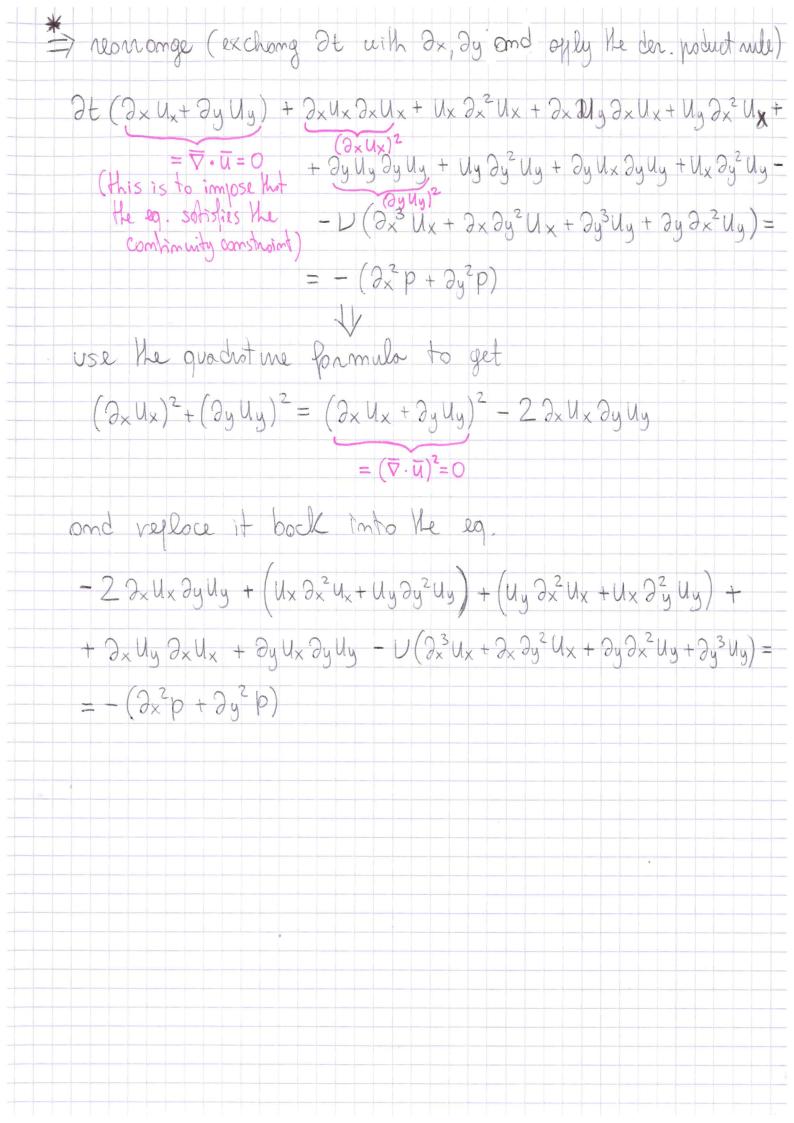
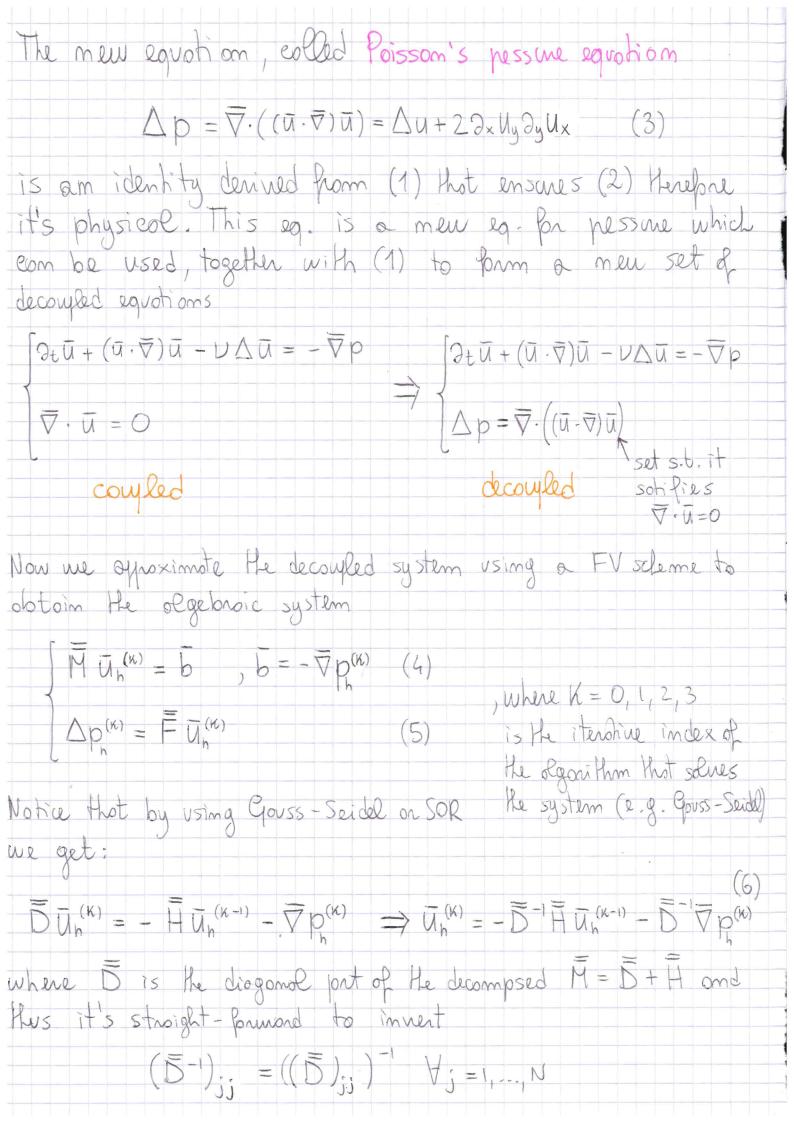
The SIMPLE (Semi-IMplicit olgonithm for Pressure-Linked Equations) olgoni Hm Incompessible N-S equations are difficult to solve numerially with traditional FVMs becouse of coupling between jussine and velocity in the momentum equations Remoinder: incompessible N-S is a set of transient & equations (1 scalar continuity eq. and 3 scalar mamentum equotions, one for each slotial component of the vector momentum equation) in 4 variables (ux, uy, uz, p) Reinterpretation: nother than thinking to the continuity equ. os on additional DOF of the system one thinks of it as a constraint in stead i. e. I some momentum eq. independently and Hen I want my solution to sotisfy the continuity eq. Solution: derive from momentum eq. an eq. for pessure so that the system is decoupled; oftenword derive a corrector s.t. it ensures that u does sotisfy the constraint impsed by the continuing $\int \partial_{\tau} \overline{u} + \overline{u}(\overline{u} \cdot \overline{\nabla}) - \nu \Delta(\overline{u}) = -\overline{\nabla}(p)$ (momentum eq.) (1) $\nabla \cdot \overline{u} = 0$ (continuity eq.) (2)Apply div operation to (1) (here shown for 2D cose only, x=(x,y)) $\nabla \cdot ((1)) \Rightarrow \partial_{x}(\partial_{t}U_{x}) + \partial_{y}(\partial_{t}U_{y}) + \partial_{x}(U_{x}\partial_{x}U_{x}) + \partial_{x}(U_{y}\partial_{y}U_{x}) + \partial_{x}(U_{y}\partial_{y}U_{x}) + \partial_{x}(U_{y}\partial_{y}U_{x}) + \partial_{x}(U_{y}\partial_{y}U_{x}) + \partial_{y}(U_{y}\partial_{y}U_{x}) + \partial_{y}(U_{y}\partial_{y}U$ + 2y (Ux 2x Uy) + 2y (Uy 2y Uy) - V (2x (2x Ux) + 2x (2y Ux) + $+ \partial_y \left(\partial_x^2 U_y \right) + \partial_y \left(\partial_y^2 U_y \right) = - \left(\partial_x^2 p + \partial_y^2 p \right) \qquad \stackrel{*}{\Longrightarrow} \qquad$





Eq. (6) will be our momentum redictor in which (by solving it) me il derine a prediction for the velseity field colled intermediate velocity field. Eq (5) will be our pessure correction equation in which me compute a pessure volue s.t. it sotisfies he continuity equation and that we will use to y date the velocity field SIMPLE PSEUDO CODE guess on initial value for p(0) Pon K=0: miter 11 toll < 1e-10 solve (6) to obtain Un(n) put Un into (5) and obtain updated p(n) that sonsfies (2) set p(n+1) = p(n) SIMPLE IN OF p. stone PrevIter (); tmp < f v Vector Motrix > UEgm); frm::dir(phi, U) - frm:: laplacion (mu, V) solve (UEqm == - Evc :: grad (p)); vol Scolon Field D= UEgm (). A(); U=UEam.H()/D; Ev Scolon Motrix pEgm); frm:: laplacion (1.0/D, p) == frc :: dir (phi) p Egm. solue (); U -= frc :: grad (p)/D; V. correct Boundary Conditions ();

The SIMPLE organithm is usually not recommended for unsteady flows the reason being that as the disretization step At in the time derivative

Ut ~ U(m+1) - U(m) Dt=tm+1-tm gets smoller the more this term tends to dominate the sporiol distretizations in Du and V. (U&U). As such the linear system tends to be more diagonally dominant on a requires under-relexation of the momentum equation