SIMPLE Algorithm

Qw Zhang

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1 Governing equations

Here, we consider a simple 2-D incompressible creeping flow (e.g., mantle flow) with constant viscosity

1.1 Mass conservation

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0 \tag{1}$$

where u and v are velocity in $x-$ and $y-$ direction, respectively.

1.2 Momentum conservation (Stokes Equation)

$$\begin{aligned} \frac{\partial p}{\partial x} &= \mu \left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} \right) + \rho f_x \\ \frac{\partial p}{\partial y} &= \mu \left(\frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2} \right) + \rho f_y \end{aligned} \tag{2}$$

where p, ρ, μ and are the pressure, density andviscosity, respectively. $\rho f$is the term of body force.

2 The SIMPLE Algorithm

The SIMPLE algorithm does not solve these coupled equations (eq.1 and eq.2) simultaneously. Instead, this can be done in a iterations fashion with several *seperate* steps until the solutions of velocity and pressure are accurate enough (fig.1).

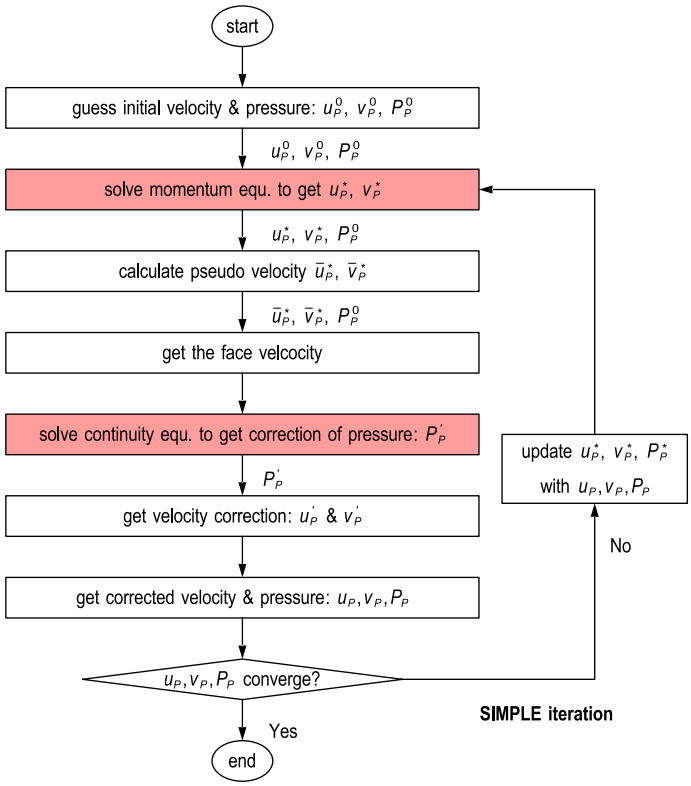

Figure 1: A simplified flow chart of the SIMPLE algorithm solving eq.1 and eq.2. The processes in the red boxes solve the equations, while others serves as auxiliary processes preparing the intermediate data