Mathematical Modeling, Fall 2016
Projects Evaluation

Contents

1 Group 1

Q1.1: The energy balance is not done properly. The expressions for the work and kinetic energy are wrong.

Q1.2: The table is ok but does not include essential design features such that the width of the channels. No interpretation of the dimensionless quantities is proposed.
Q2.1: Good
Q2.2: Very good. Uses Reynold's theorem.
Q2.3: Do not split into viscous forces and pressure forces but it is ok.
Q2.4: Mixed no-flux and no-velocity condition.
Q3.1: Unclear
Q3.2: Argue that $v'(0) = 0$ because the velocity is maximum in the middle of the channel but it is more a question of symmetry. Nice: Use numerical simulation to support their result.
Q3.3: Nice presentation of the separation of variable but the coefficients of the Fourier series are not computed. Too bad! However, numerical compuations are provided.
Q3.4: Comes to the conclusion that cross-section with more corner gives more damping. It does not seem to be the case if we look at the results of the other groups.
Q4.1: Ok but did not get the meaning of $\bar{u}$ as an average.
Q4.2: Ok.
Q4.3: Nice reasoning about the non-existence of stationary solutions in the case where $u = 0$ at outlet. They could however have looked at other boundary conditions.
Q5.1: They do not provide any argument and get wrong the 3D case.
Q5.2: Nice. They choose a mass loss constant which matches the inlet value.
Q6.1: Good.
Q6.2: Compute a particular case, while believing they handle the general case.
Q6.3: Did not get the geometry
Q6.4: Same as above
Q6.5: Ok, but again miss the geometry
Q7.1: Takes $u = 0$, which is problematic as nothing enters the porous media. In the force balance, do not take the viscous forces, just pressure.
Q7.2: Ok. Not sure about expression for ϕ
Q7.4: Ok.

Presentation: Nice slides and presentation, on time. Got 2 votes.

2 Group 2

Q1.1: The energy balance is not done properly. The expressions for the work and kinetic energy are wrong.
Q1.2: Do not get much from dimensional analysis
Q2.1: Ok.
Q2.2: Good.
Q2.3: Problem with pressure term in t_i, otherwise very good.
Q2.4: Good enough.
Q3.1: Make some unnecessary extra assumptions that they could have proven. Just at the end, restrict themselves to the cylindrical case to get the general formula for a - even if it was not necessary to do so to obtain it. Otherwise good and well-written.
Q3.2: Do not derive the solution. Find it in a reference but it is ok.
Q4.1: A bit short : Just state that grad operator can be replaced by $\frac{\partial}{\partial x}$ and that u is replaced by u_1.
Q4.2: Ok.
Q4.3: Shut the channel at the end and do not investigate other BCs. Numerical results are difficult to interpret. Do not transform the system so that they get something that can be solved using Matlab.
Q4.4: Looks good.
Q5.1: Introduce some Dirac that they do not use afterwards. Miss the 3D case.
Q6.1: Ok.
Q6.2: Compute a particular case, while believing they handle the general case. Include illustration drawing.
Q7.1: Assume zero velocity at interface. compute total global mass loss and use it as constant.
Q7.2: Ok, given the assumptions done previously.
Q7.4: No idea if it is good but since the model is wrong.
Q8.1: Nice illustration figure. Same problem as before but otherwise ok. Some typos.
Q8.2: Attempt to solve numerically.

Presentation: Nice slides, ok presentation, on time.

3 Group 3

Q3.1: Consider incompressible case. Start with Navier-Stokes. Do not provide definition of a for general cross-section.

Q3.2: Really missing more details, otherwise ok.
Q3.3: Looks good. They state the computation is *fairly routine* but I really miss the details
Q4.2: Looks good.
Q4.3: Nice plots, but it is not clear why they do not get $(\rho u)_x$identically equal to zero.
Q5.1: Look ok.
Q5.2: They pretend that the value of $(u\rho)_x$ should approach ϕ but there is no sign of that in the simulation, which looks very similar to the previous case.

Presentation: Ok slides and presentation, only 3 minutes long. Got 2 votes.

4 Group 4

Q1.1: Very nice energy balance. Get the correct expression for work.
Q1.2: Ok. Value ar not interpretated.
Q2.1: Good.
Q2.2: Good.
Q2.3: Clear, very good.
Q2.4: We need BC for both momentum and mass. good enough.
Q3.1: Ok, could have been clearer.
Q3.2: Very good
Q3.3: Excellent.
Q3.4: Very nice. Use the analytical solution to assess quality of the numerical solutions.
Q4.1: Good. Do not mix component and average.
Q4.2: Ok.
Q4.3: Nice expression. Could have tested other BCs.
Q5.1: Very good. I am not sure that the momentum loss can be modeled as ϕu since the mass that leaves the channel has almost zero speed. Recall that u is only the average speed and moreover in the x direction. Later, we assume that the mass leaves the channel in the orthogonal direction, so that it will not contribute to any momentum loss in the x direction.
Q5.2: It seems really that the oscillations arise because the equation becomes ill-posed for $u = 1$. They do not comment on that.
Q6.1: Good.
Q6.2: Not done for the general case.
Q6.3: Very good.
Q6.4: We cannot use radial symmetry for square.

Q6.5: Very nice argument for this case where they obtain a quadratic dependence. It would have been nicer if they had developped the argument rigorously in Q6.2

Presentation: Nice slides and presentation, on time.

5 Group 5

Q1.1: The energy balance is done correctly. Do not consider work done by gas at inlet and outlet.
Q2.1: Ok.
Q2.2: Mention Reynold's transport theorem but I miss more details about the derivation.
Q2.3: Ok.
Q2.4: Not clear. Nothing about pressure.
Q3.1: The definition of a is not given.
Q3.2: Do not derive the solution. Take it from reference but it is fine.
Q3.3: Almost no detail about the derivation.
Q3.4: Comes to conclusion that the coefficient depends on the non-smoothness of the solution. Probably wrong.
Q4.1: To get from 3D to 1D, just remove the variables that does not belong to the remaining dimension. This is not the way to proceed.
Q4.2: Ok.
Q4.3: Looks good. no numeric.
Q5.1: Good. Go thoroughly through the derivation in 1d case. The 3D case is not covered.
Q5.2: Nice, the mass balance is included to set up the simulation. Nice simulations.
Q6.1: There is no conservation of momentum in the porous media model. The kinetic energy is completely neglicted. The Darcy's velocity is not a particle velocity.
Q6.2: Very nice. They provide a general definition for a, independent of the geometry.
Q6.3: very good.
Q6.4: Nice. Even if it is oversimplified, the approach and its limitation are clearly presented.
Q6.5: Very nice. Solve the problem for the radial case.
Q7.2: Looks good,
Q7.3: Good.
Q7.4: Nice numerics!

Q8.1: Nice and clear.

Presentation: Nice slides, ok presentation, 1 min over time. Got 2 votes.

6 Group 6

Q1.1: They assume that the energy loss in the tube is negligeable but it is precisely what we want to estimate! Do not take into account the work in the energy balance.
Q1.2: No characteristic length in the parameter list.
Q2.1: Good.
Q2.2: Good, well-explained.
Q2.3: Derive again divergence theorem on a box but it is ok.
Q2.4: Need BC for both momentum and mass. OK.
Q3.1: Good.
Q3.2: Good
Q3.3: Good, but I miss some computation details.
Q3.4: Nice.
Q4.1: They see that the average should be considered but otherwise set term to zero without further explanations.
Q4.2: Ok.
Q4.3: Short. Do not consider other BCs.
Q4.4: Should consider time dependent equation. There is no real point of considering the perturbation of the stationnary case.
Q5.1: Good, 3D case is handled correctly.
Q6.1: Ok, same comment as other group, concerning the extra term in the momentum equation.
Q6.3: Good
Q6.4: Wrong splitting of the solution to the Laplace equation.
Q7.1: Unclear.
Q7.2: Ok
Q7.3: Not clear, no details are given.
Q7.4: Looks good.
Q8.1: looks good.
Q9.1: Good.
Q9.3: Not sure what is meant in the expression for $c(t, x)$. Rest is ok.
Q10.1: Wrong to sum up the permeability.

Presentation: Nice slides and presentation, on time. Got 1 vote.

7 Group 7

Q1.1: The energy balance is not derived correctly. The work exterted by the gas at the outlets is not considered.
Q1.2: No characteristic lenth is given. The dimensionless quantities are not interpretated.
Q2.1: Ok.
Q2.2: Good.
Q2.3: Good. Miss details fro the pressure term.
Q2.4: Do not provide boundary condition for a general geometry. No BCs corresponding to momentum equation, such as pressure, are given.
Q3.1: Equation for a is not clearly presented.
Q3.2: Miss details: Give the solution and claim that it can be easily checked without doing it.
Q3.3: Wrong ansatz, which is also not checked. No detail about the numerics.
Q3.4: Looks good.
Q4.1: Do not explain the interpretation of u as an average. Otherwise, looks good.
Q4.2: Looks ok.
Q4.3: Looks good.

Presentation: Nice slides and presentation, on time.

8 Group 8

Q4.1: Good, really define the one-dimensional u as a cross-section average.
Q4.2: Ok.
Q4.3: Looks ok. Do not investigate other BCs.
Q4.4: Should have considered time-dependent equation.
Q5.1: No derivation is given for 1D case. In particular, no explanation for the extra term in momentum equation. Nothing on 3D case.
Q5.2: Good, consider total mass balance to set boundary condition. Good numerics.
Q6.1: Ok, but the 1D case is not relevant here. This confusion creates problem later.
Q6.3: Miss the geometry.
Q6.4: Miss the geometry.
Q7.1: They balance the **gradient** of the forces at the interface, not the forces themselves. However, they consider all the contributions (pressure + viscous forces).

Q7.2: Good.
Q7.3: Not given.
Q7.4: Numerics looks good but no detail on the BCs.
Q8.1: Propose a very simplified expression where all the terms are integrated.

Presentation: Nice slides and presentation, one min over time. Got 1 vote.

9 Group 9

Q1.2: Nice presentation but the dimensionless quantities are not interpretated.
Q2.1: Ok.
Q2.2: Good.
Q2.3: I miss the detail for the pressure term. At some point in the text, start talking about *cars*! Otherwise ok.
Q2.4: Do not handle general case, only 1D case.
Q3.1: Do not include a clear definition for a, otherwise ok.
Q3.2: Wrong expression for the solution. No derivation details are given. Finally, they get the right coefficient.
Q3.4: Nice numerical simulations. Very nice: they take the initiative to consider an extra case (triangular case) and show the relationship between cross-section area and perimeter length.
Q4.1: Good. Derive the derivation again in 1D case and include discussions.
Q4.2: Good.
Q4.3: Very good. Identify the singularity.
Q4.4: Very good.
Q5.1: Very good treatment of the momentum equation. Consider two cases. Do not cover the 3d case.
Q6.1: Ok.
Q6.3: Very good.
Q6.4: Wrong. No details are given.
Q7.4: Nice study of diffusion, which was not proposed in the text. This case can be very relevant when considering a *sticky* wall and no mass loss through the wall. Indeed for an infinite channel, if there is no diffusion, there will be no particle attaching to the wall, as the velocity there is zero. Thoroughly prepared numerical simulations with nice result. Smart solution procedure for the hexagon case.

Presentation: Very nice slides and presentation, on time. Got most votes (3).

10 Group 10

Q1.1: very few details. Only take work into account in the energy balance.
Q2.1: Ok.
Q2.2: Good.
Q2.3: The pressure gradient is just added without further comment.
Q2.4: Mix flux and velocity. Set up boundary condition with pressure gradient with respect to x, which I do not understand and which is not explained.
Q3.1: Use the linearity of the equation to argue for the existence of a. Ok.
Q3.2: Do not understand why u is assumed to be zero at the center. Do not fulfill the computations.
Q3.3: Wrong ansatz. They seem not aware that the linearity of the equations, and therefore solutions to the homogeneous equation, are essential ingredients in the method of separation of variables.
Q4.1: Do not interpret $\bar{u}$ as an average. Only remove the extra components.
Q4.2: Ok.
Q4.3: Plot phase-plane but in this case, such plot does not give much insight.
Q4.4: Compute the Jacobian but this only makes sense around an equilibrium point (for autonomous system).
Q5.1: Nice derivation for the 1d case for the mass equation. Introduces mass loss in momentum equation without any explanation. Nothing for 3D case.
Q5.2: Discuss the boundary value problem. Good but do not realize that they require too many BCs. No numerics.
Q6.1: Ok.
Q6.2: The general case is not covered.
Q6.3: Wrong. Assume linear pressure radial decay and seemingly without beeing aware that they are doing so.
Q6.4: Wrong, same as before.
Q6.5: Wrong, same as before.
Q7.1: Ok.
Q7.2: I cannot see the coupling with the porous layer.

Presentation: Nice slides and presentation, on time.

11 Group 11

Q1.1: The energy balance is not done correctly. No work exerted by the gas is considered.
Q1.2: Ok, but no interpretation of the dimensionless quantities.
Q2.1: Ok.

Q2.2: Problem with notations.
Q2.3: Good, pressure is nicely included.
Q2.4: Ok. Just need BCs for both mass and momentum equation.
Q3.1: Unclear.
Q3.2: Good.
Q3.3: Nice.
Q3.4: Looks good.
Q4.1: Reduce simply the divergence operator to 1D but get that the average should be considered.
Q4.2: Ok.
Q4.3: Detailed parameter study is included. No numerical simulation.
Q4.4: Looks good.
Q5.1: Ok for 1D. 3D not treated.
Q5.2: Good. Total mass balance is used to set up the numerical computation. Strange results for simulation (linear decay for pressure). Uses the MATLAB function to solve boundary value problems (not known to me)
Q6.1: Ok.
Q6.2: Mistake in computation of the integral leads to wrong result.
Q6.3: Wrong result due to previous error
Q6.4: Wrong result due to previous error
Q6.5: Very nice derivation!!
Q7.1: It is not true that Navier-Stokes simplifies to Stokes when the fluid is incompressible, it happens when the kinetic energy is neglected. Otherwise ok but nothing is said about force balance.
Q7.2: No coupling is introduced.

Presentation: Nice slides and presentation, on time.

12 Group 12

Q1.1: Do not set correctly the energy balance and the work exerted by the gas at the outlet is not included.
Q1.2: No characteristic length is included and no derivation detail.
Q2.1: Ok.
Q2.2: Good.
Q2.3: Good. Include neatly pressure term.
Q3.1: Assumptions are clearly stated. Good.
Q3.2: Good but no expression for a is given at the end.
Q3.3: Good litterature research, clearly presented.
Q3.4: Looks very good.