MOOSE Part 1 Grading Notes

CeCe

Good outline and justification of materials properties. Word sucks for equations, why not use latex? So much easier… Typo in your UO2 k(T), parenthesis in the wrong place. The gap has the lowest thermal conductivity, you say it is the fuel. You’ve had to lower the tolerances quite a bit. Seems your convergence is rather poor. Can maybe do some tweaking with petsc parameters? Not sure, but it shouldn’t be so hard to converge. Did you verify that the main contributor is the gap/cladding k(T)? What do the delta T’s across each block look like? So, your transient with k(T) gives a pretty wrong value for centerline T, when it should converge to the exact same value. But I looked and do NOT know why it isn’t converging to the same result. I spent too much time fighting with it. Just not sure. But… some issues to work out here.

Grade: 87 -5 = 82

Anthony

Defined material properties, all reasonable. Cited where needed. I like the work through of the fundamental equations. In equation 4, you have a square on the divergence, which doesn’t make sense. I like your method of setting up the mesh convergence. Maybe could have done nx and ny separately. In section 3.1, you mentioned a different way of doing mesh construction. I agree that this is usually preferable, but not required. Looked at stichedmeshgenerator. I would’ve liked you to have reported your values. What is the analytical temperature and what is the moose-based T? A single table would have provided this info. I see what you were doing with the volume-averaged kth, but its not that simple, since you have a temperature profile. Maybe if you discretized spatial regions and assigned temperatures, it would be closer to what is really happening. But I think just your curve in Fig 2 c is misleading. For transient, I would have liked to have gotten the actual data. What is the peak T, what time does it occur, etc. This is helpful for understanding/interpreting your results. I think I asked for peak T in the assignment. Overall, pretty good. You successfully did everything asked. Could see some slight changes in the report.

Grade: 94

Cole:

Good restatement of the problem. One error, 550 K is Tco, not 550 C. Looks like you worked through that correctly, but this was a typo. Analytical part all looks good. Did you perform a mesh convergence study? How did you settle on your prescribed mesh? I think it is probably too fine. I would argue that the most ‘sensible’ initial condition is what the prescribed temperature is. I defined the Tco as 550K, and thus I would set the initial temperature of the system at 550K. Wont make a difference in steady state, but will impact time of peak for transient. I would have liked to have seen plots of the temperature over r, showing the profile. This for constant k and k(T), then a T vs time plot for the transient. That is the best way to show the data. Also would have been good to plot the steady-state with const k data with the analytical, to provide validation evidence. Peak centerline temp for k(T) case is definitely wrong. I think you didn’t correct your units for the fuel kth. I think the equation you used is in W/m-K, not W/cm-K. Did you do mesh convergence for the transient? Just doing a more coarse mesh isn’t sufficient. By tweaking some of the tolerances in your solver, you can get it to converge. I set nl\_rel\_tol = 1e-10, nl\_abs\_tol = 1e-10, l\_tol = 1e-5, and it solved. Wanted to see more results presented. Lacking mesh convergence. Should have tweaked some of the executioner parameters. Pretty good.

Grade: 90

Gwen:

Good intro. Good mesh convergence study. Best to avoid the word ‘my’ in technical writing. Don’t need to put parenthesis around the material in table 1. Your font makes your units look like g/cm^8, which I assume it is not. Are the T-dependent k\_th values also from your references 4, 2, and 5? Its unclear the way you have done the citing in the text. In fig 2 you show the MOOSE predictions slightly underpredicting the analytical result, but fig 3 shows it slightly overpredicting. Is this the same data? Did something change? Should have a space between temperature and K, e.g., 550 K. You include an initial condition in your input files, but your fig 4 doesn’t show this initial condition being included. Where did the plotted data come from? Why does the constant k and temp-dependent k converge to the same value in fig 4? You show that they should be different in fig 3. Don’t think you plotted or analyzed the correct outputs. Overall, very good convergence behavior. You see some slight differences near the gap, because of mesh construction. But did everything that was asked for, it all works. But your files don’t quite match the presented data, which raises questions.

Grade: 92

Hongsup

Good intro to the problem. Why did you choose your mesh? Did you do a mesh convergence study? When I run your steady state case, I am not seeing the data that you show in Fig 2b. I see a smooth curve in the fuel, but an anomalous spike near the fuel/gap interface. Where does your plotted data come from? Why this jagged behavior? It shouldn’t look like this! This comes from the combinergenerator (which I tested your file without, and it looked good). The meshes are not distinct, so I don’t think the combiner is doing what you think it is doing. It might actually mess up some of the heat transport. That is for combining meshes, not combining subdomains. Also, if you were combining meshes, it should be through the stichedmeshgenerator, which combines meshes into a single mesh, and joins the boundaries. You should have reported the values for the analytical centerline T and the MOOSE result. Its hard to read your axes for comparison. But it looks like you are underpredicting. Cite where you got these thermal conductivities from. I think your files need to get cleaned up going forward to rectify this odd behavior you are seeing. I wouldn’t have expected your centerline T to rise with k(T). Transients implemented correctly. Everything runs fine. Just didn’t quite get the mesh construction right, but that’s easily fixed.

Grade: 87

Joy

Good intro. Good materials definition. I think you have a typo in your kth(T) in the report, but used the correct equation in the input file. Justify choice of mesh? Did you do a mesh convergence study? Should have to see if your choice was appropriate. Correct BCs. Better visualization is achieved in paraview if you do surface, instead of surface with edges. Analytical is not a straight line in the fuel, it is a quadratic function, would have been better to show the continuous function. Your csv file had too few points in it, so it shows the transitions oddly, especially at the gap/fuel interface. Not sure what the values for k are in equation below Tn=T/1000: k=0.0616 W/cm-K, and the one for cladding just below it. Those are for a fixed T, so I’m confused what values you actually used. Really only needed one image like that in Fig 2. Adding in Fig 3, 6, and 7 don’t really contribute much, except space eating. I don’t think you can report an average thermal conductivity *a priori*, which it seems is what you are doing in comparing the 0.03 to 0.0616 W/cm-K. This will depend on what the temperatures in the system are, and thus it is coupled. Good image showing T vs t. Everything runs, good convergence behavior. All looks right. Just some questions on the analysis of effective kth.

Grade: 95

Lexi

Good intro. Outlined everything appropriately. UN isn’t really a traditional nuclear fuel… SS isn’t an option in LWRs, more used in other reactor systems (but not really used anywhere anymore except core internals). References shouldn’t be at the start of a caption. Your figure 2 is actually a table. It looks like you meant to insert a table, but inserted an image of a table… This messed up your image numbering later on. Well-described sections on all requirements in the input file, well-organized. Few typos here and there, but nothing major. Better to write UO2 as UO$\_2$, instead of $UO\_2$. Could probably have condensed some of your sections. A single section describing the different kernels, outputs, postprocessors, including information on the different cases, would have been more streamlined. The way it is written feels repetitive or redundant. Better to write equations than to paste a picture of equations. I don’t think you are right about the change in the cladding k being the determining factor here. You show basically the same slope in fig 8 in the cladding. This means that the k in the cladding is the same for constant or variable k. But you do have a change in the gap delta T. You also get small changes in the fuel. Depending upon the chosen constant value in the fuel, and the resultant temperature ranges, you may get an increase or a decrease in the effective k of the fuel. Your results is not well organized, with just a steady-state LHR section and a discussion section, with all results piled in. Also would have been better to use some float barriers to separate the figures and associate the figures with the text which describes them, instead of have all figures stacked. Overall good. Code runs, converges well. Results are all reasonable. Slight misinterpretation of results. I didn’t need to see the code in the report. You are submitting files separately.

Grade: 95

Tim

Good setup. Its typically preferable to abbreviate your units, e.g., W/cm-K, just to condense things and make it look cleaner. Only 7 K across the cladding looking weird. And yes, you mixed up the dimensions. You put in 0.01 cm, instead of 0.1 cm. If you look at fig 2, you can see your cladding is as thick as your gap, basically, which should tell you something is off. But you are consistent with this typo throughout, so it doesn’t mess other things up. Did you do any mesh convergence study? Would have been good if you did. You might have even been able to use a coarser mesh. I didn’t need to see the code in the report. You are submitting files separately. If you wanted to include in an appendix, ok, but even that isn’t needed, since its literally part of the submission. So it looks like you didn’t add in a HeatConductionTimeDerivative kernel. This is needed to do the time dependence in the transient. Where did the other properties come from? I don’t think I provide cp or density for all of your materials. You need to cite these. Problems with convergence. Mesh setup is good. But couldn’t finish all of the transient runs, I think this is due to the lack of the time derivative kernel.

Grade: 87

Vaughn

Would have liked a brief intro into what you are doing. Very good mesh refinement study. Done in an ideal and robust way. You should cite where these values are coming from, even if from lecture notes. BC was 550 K, not C. But it looks like this was a typo and implemented correctly in the code. We usually don’t do degree symbol with Kelvin. Its just 300 K, for example, without the degree. Good finding on the interface issues. When we have sharp changes in material properties, MOOSE has a harder time solving things. We often need more fine meshes near the transitions. I did a test case with your transient k(T) simulation with mesh adaptivity. It slows things down a lot, but can lead to a more accurate solve. But its not really needed for this case. Cite material properties, ideally with proper references. Did you report data for steady-state with k(T)? Don’t see it in the report, nor do I see a file for it. Ideal initial condition is 550 K. We are using this as the BC, and it makes sense that the entire system would start at this value. Using different initial conditions makes the comparison in Fig 8 a little wonky. Don’t really know what your AuxVariables are doing here, just as a potential post-processing tool? Code all looks great. Very good job.

Grade: 96