Madeline Cook

CSCD 577

Scalar Data Visualization

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**Iso-surface extraction:**

Through iso-surface extraction one can see the differences in the shape of a specific temperature. The iso-surfaces have been taken at intervals of 0.05, the table below show the analysis at each interval, there will be an analysis of the over all temperature change and flow after the individual analysis.

|  |  |  |
| --- | --- | --- |
| **Interval** | **Photo of Iso-surface** | **Analysis** |
| **0.05** |  | The iso-surface at this temperature is shaped like a shallow bowl or a plate on the right side of the graph. This was where the cold plate was the closest to the air, thus the coldest temperature is closest to that cold plate. |
| **0.1** |  | The iso-surface at this interval is still shaped like a shallow bow or a plate but the walls of the bowl or plate are just a bit taller. The walls are taller because this temperature interval is slightly warmer than the last interval, but it is still cold and very close to the cold plate. |
| 0.15 |  | The iso-surface at this interval is starting to change shape into more of a bowl. This is due to the air being warmer at this interval and the colder air mixing with the warmer air along the edges of the experimental space. |
| 0.2 |  | At this interval the iso-surface is still mostly bowl shaped, however there is now an outcropping at on the bottom of the is-surface, this is because the colder air is mixing with the warmer air and creating that out cropping. |
| 0.25 |  | The iso-surface at this interval has the upper portion that is shaped like a bowl. This lower portion has a larger outcropping that is starting to take the shape of a deeper bowl or cone. Once again this is because the cold air is being pulled toward the side of the experiment with the hot plate. |
| 0.3 |  | The iso-surface at this interval again is the same general shape as the previous, however the cup/bowl on the bottom is quite a bit more pronounced than the others. Once again this is because the colder air is being pulled toward the side with the heat plate as it is pulled toward the heat plate it is getting warmed up by the heat plate. |
| 0.35 |  | At this interval the iso-surface has an even deeper, wider, and more pronounced bottom cup. Once again this is because as the air is heating up it is getting pulled toward the hot plate and the slowly pulled away from the cold plate. |
| 0.4 |  | The iso-surface at this interval is starting the have the shape of two bowls attached along an edge. This is because the cold air and hot air are continuing to mix together and as the cold air is being pulled toward the hot plate the hot air is being pulled toward the cold plate. |
| 0.45 |  | At this interval the iso-surface is the same general shape as the previous, however it is more obvious that the cold air is being pulled toward the hot plate and the hot air is being pulled toward the cold plate. |
| 0.5 |  | The iso-surface at this interval is the shape of two bowls attached at the corner. This shape makes the mixing and current of the air obvious. The cold air is being pulled toward the hot plate and the hot air is being pulled toward the cold plate. It is evident now that what the iso-surfaces are showing is a convection current. |
| 0.55 |  | the Iso-surface is starting to shift towards having more area on the side towards the hot pate, this is because the temperature of this iso-surface is warmer, but also this showcases the convection current well. |
| 0.6 |  | The iso-surface at this interval is starting to look like the inverse of the colder iso-surfaces, specifically interval 0.4. This symmetry show cases the convection current. |
| 0.65 |  | The iso-surface at this interval is the inverse of the iso-surface at 0.35 once again showcasing the symmetry of a convection current. |
| 0.7 |  | The iso-surface at this interval is the inverse of the iso-surface at 0.3 once again showcasing the symmetry of a convection current. |
| 0.75 |  | The iso-surface at this interval is the inverse of the iso-surface at 0.25 once again showcasing the symmetry of a convection current. The hot air is being pulled toward the cold plate. |
| 0.8 |  | The iso-surface at this interval is the inverse of the iso-surface at 0.2 once again showcasing the symmetry of a convection current. |
| 0.85 |  | The iso-surface at this interval is the inverse of the iso-surface at 0.15 once again showcasing the symmetry of a convection current. |
| 0.9 |  | The iso-surface at this interval is the inverse of the iso-surface at 0.1 once again showcasing the symmetry of a convection current. |
| 0.95 |  | The iso-surface at this interval is the inverse of the iso-surface at 0.05 once again showcasing the symmetry of a convection current. |

As stated in the individual iso-surface analysis, the data is showing a convection current in air flow. A convection current is a current that forms when a fluid or gas is heated on one side of a vessel and cooled on the other. The substance that is headed eventually cools down and sinks then is pulled back to the heated portion of the vessel. A convection current is important for fluid dynamics and many real-world applications take advantage of this phenomenon.

**Probing Analysis:**

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| **Interval** | **Probing image** | **Analysis** |
| **Z=0** |  | When z=0 in probing we can see that there is the side where the hot plate is and the side where the cold plate is. There is some area in the middle where the air is a middle temperature. |
| **Z=1** |  | When z=1 the hot plate side and cold plate side can still be observed, however, the center where the air is a middle temperature is starting to take on a different shape. It is starting to become more “s” shaped. |
| **Z=2** |  | When z=2 again the hot plate and cold plate can still be observed, but the middle temperature values are further developing into the “s” shape in the previous image. |
| **Z=3** |  | Then z=3 the “s” shape is even more pronounced and is starting to show the way that the colder air is being pulled and warmed by the hot plate and the hot air is being pulled and cooled by the cold plate, creating a convection current. |
| **Z=4** |  | When z=4 there is a similar effect that was shown when z=3 the convection current is being developed as the warm air cools and the cold air heats up. |
| **Z=5** |  | When z=5 again there is a similar image to the previous 2, the colder air is being pulled more towards the hot plate and the hot air is being pulled toward the cold plate to create a convection current. |
| **Z=6** |  | The next 4 Images just further showcase the convection current and are all very similar to the previous few images because at this point the convection current is well developed and apparent. |
| **Z=7** |  |  |
| **Z=8** |  |  |
| **Z=9** |  |  |

**Overall analysis of the data:**

This data is showing a convection current in a vessel with a hot plate and a cold plate, the air is heated, then cools and falls toward the colder side, then is pulled back towards the hot plate. As stated, before this is an important concept for fluid dynamics, physics and engineering.