ECE 6560 Final Project - Image Smoothing

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1 Problem Description

First describe the problem you wish to solve (or attempt to solve) without using mathematical language (or at least as little as possible), so that somebody with an engineering background but who doesn't know the specific mathematical tools discussed in this course will still clearly be able to follow the description.

2 Mathematical Modeling

Next, "translate", your problem into a mathematical problem. For example, if you are using variational gradient descent PDE's, you may want to explain how to formulate an energy functional that captures the aspects of your problem into a mathematical expression. You don't necessarily need to introduce the PDE yet in this section. This section, should just focus on how to encode your problem mathematically.

3 Derivation of PDE

Next, show how the PDE you intend to use to solve your problem is derived or formulated from your mathematical model. For example, in the case you are using a variational gradient descent PDE, here is where you will show how to obtain your gradient flow PDE from the energy function that you already presented. Make sure it is clear to me that you understand how the PDE is obtained (don't just present it with no explanation).

4 Discretization and Implementation

Now, show how the PDE you are using should be discretized and implemented on the computer. You should justify the choices you make in the discretization (why, for example, are you using central differences or upwind difference or entropy differences for the spatial derivatives, how and why are you choosing the time step if your PDE is a time evolution PDE). Make sure it is clear to me that you understand the reasons behind your choices (don't just present them without explanation).

5 Experimental Results

Now present some experimental results from applying your discretized PDE methods on data. The data can be synthetically generated or real data (real data is not important for this project). If you are exploring more than one PDE model (and/or testing the effect of changing some parameters in your PDE model), then make sure you present multiple experimental results. Attempt to extract/present some quantitative information to compare results rather than just showing only images. For example, if you are doing anisotropic image diffusing to preserve edges, you can devise any sort of reasonable quantitative measure to compare the edge preservation effects between different PDE choices, and then present a table of the comparisons (or a plot showing the way this value changes with the number of PDE iterations for each choice of your PDE).

6 Summary

Finally, discuss what we have learned (beyond what was already covered in lecture) as a result of your project. This can be both positive and negative. In otherwords, you may have discovered a weakness as well as a strength in your PDE based approach while doing your experiments. Try to related the strengths and/or weakness discovered during your experimental testing to the assumptions (or lack of assumptions) made in the mathematical formulation of your problem. In the case of weakness, suggest what you might do in the future if you had more time to reformulate, adjust, or improve your model and/or your discrete implementation algorithm.