

Chapter 7.3 - Movies and Animations

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SUMMARY

This chapter concludes on visualization by focusing on creating movies and animations to effectively convey data dynamics and computational results. The use of animations enhances understanding and communication of complex information, making it easier to share insights with others.

- *Animations and movies are powerful tools for visualizing data dynamics and computations.*
- *Static images can be limiting; animations provide a clearer representation of changes over time.*
- *The process involves creating snapshots at different time points and compiling them into a movie format.*
- *Python's Matplotlib library can be used to create animations, with specific commands for generating and saving frames.*
- *The example discussed involves creating a spiral wave animation through a series of 30 frames.*
- *The importance of aesthetics in each frame is emphasized, as beautiful figures enhance the overall quality of the animation.*
- *The methods for creating animations may evolve over time, so staying updated on best practices is essential.*
- *Good visualization techniques, including animations, significantly improve the ability to communicate complex ideas effectively.*

We're going to finish this chapter on visualization with showing how to make movies and animations. So, this is going to be a really great way to show off interesting features of your data or even aspects of the computations that you've been working on. So, I love good animations and good movies. They show quite a bit. We learn a lot from it. So really this is all about using the visuals for learning and to understand what's going on with your data or with your computations. So making movies or animations of what you're simulating is a really nice thing to be doing. So let's start off with something like this. Here's a spiral wave, right? It's flipping around here. And so this is essentially you know this is very difficult to convey this information with a static image because you can only show one snapshot of this. But here you can see the dynamics that are happening.

And so typical graphical illustrations like this are very nice. And of course you can always put this in a nice slide deck to show people here's the dynamics of what's going on here. And so when you start looking at when we do scientific computing, especially in the next sections that we have coming up, you want to have a way to represent the dynamics of what you're showing. And here's a nice way to do it. But this will require you to make this animation, which is a bunch of essentially snapshots of different time points and append it into a movie type structure that you can play back. And there's so many different ways to make movies. So what I'm going to show you here is only one way to make a movie. So if you just even query someone something like Claude or Chat GPT you can find lots of different ways to make animations and movies. So I'm just going to show you one of them here which comes from Maplot Live using the animation feature that they have and import function animation. Okay. And so we're going to bring that in. We're also going to import pillow from image.

Okay. And these are going to be the two tools we use to essentially create snapshots of a movie, append them together into essentially going to be a little AVI film for us. Okay. So, first of all, I'm going to make some data. I'm going to define an XY domain and mesh grid that. So, that's a very simple thing to do. The second thing I'm going to do is now go here and I'm going to define essentially the number of frames I'm going to go through. Okay, there's be essentially going to go through this thing 30 times. Be 30 frames and each frame is going to be this spiral wave spiral wave advanced Δt into the future. So when I take 30 frames, it's going to be the spiral wave at one time point and then in a second time point and then a third time point. Okay, that's how we're going to make this movie and it's going to be right there. So that's going to be how we we make this advance the spiral wave.

Okay, so that is essentially it. Here is where the J is added. J is our time essentially. So that is what's going to happen here is we're going to essentially go from J equals 1 to 30. And it's going to take 30 steps to make this movie. And you're and that's the spiral wave I just showed you. So the first thing we do is make a figure. You pick the figure size. I'm going to pick a color map that I want to go with it.

There's there's the color map I might have. I'm going to pick even a title. And notice what I'm going to do here. I'm going to call it by the frame number. So the title is going to have the frame number in it as we go through. Okay. So that's going to be how we do this. And then I'm going to plot and use the save fig command. I'm going to plot it here to a file. There's going to be a directory called movie. So you're going to make a directory called movie. And into that movie is going to be written frame by frame a PNG file for each frame. So for instance, you're going to plot at time zero what the solution looks like at a PNG file that looks makes that movie frame and then when it advances one Δt which is now going through this J loop, it's going to be the next frame of the PNG and the next frame. There's going to be up to 30 frames of this PNG. And every time I make this, what I'm going to do after I've done it, I'm going to go ahead and close that. And then I'm going to use here the image command and I'm going to append to this a frame. So each frame I append the next frame. So it's very much like making a movie. You have frame by frame. You dictate which frames are going to be made. And here is a loop making 30 frames that get appended together. And once you have it appended together, you're done. You can come back out and actually play this thing. And it's a GIF animated GIF movie. Sorry.

Okay. So, that's what it's going to make for you. And so, that's exactly what you're seeing here is an animated GIF. Okay. So, each one of these was a frame of a mathematical expression that I glued together and appended. And there's 30 of them here. And this is the basic command structure for this. And again, I want to emphasize this is only one way to make a movie. There's a lot of different ways you can make movies in Python. And one of the things I found that over the years making movies is one of the things that changes the most over time in terms of what's the best architecture. If you notice, we keep changing the formats of movies, right?

So there's megs, AVI, movie. This keeps changing over time as we improve the quality and the compression. And so whatever I show you here is just one architecture for doing it. But you should be on the lookout for what is the best way to do this. And you can always query for instance claude or GPT to say hey what's the best way to make a a nice movie file for visualization. So this is one way to do it. But I imagine in a year, half a year, two years, this will change significantly.

At least what I found is making movies or the files that make movies. That's the thing that changes the most. But very powerful to use this because it's a nice way to do representation of the dynamics of your things of whatever you're trying to compute or show. So use it make nice movies and you know there's a lot of nice ways to do this but also at each frame you can make a very beautiful figure and then you put that in and that's just one frame at a time and notice that all the work you do to make a beautiful figure gets repeated from frame to frame. So it's it's essentially reused and so it's certainly worth the time to spend to make a nice graphics as you go. So again, movies and animations is the final piece of this visualization chapter. Spend some time with visualization. It's one of the most important pieces that you have that you should be working with or be thinking about because if you make good movies in animations, it's a lot easier to convey your ideas to others because they can really see the results of what you're trying to share from the information you've done either computing or what the data might show to people.

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