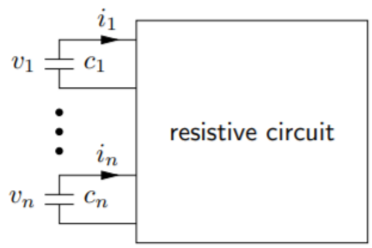
Applications of ADI.pdf consists of 3 applications; one Discretized PDE, one for Dynamical Systems and Control Theory, and one for Denoising Images. These examples were primarily based on the survey Computational Methods for Linear Matrix Equations (pdf)

For the Dynamical Systems/Control Theory example, the goal is to model VLSI as a dynamical system over time. For now I have chosen to look at discrete time intervals. The application to VLSI is mentioned in this paper (2. Motivating Examples) but the details of how to model a circuit aren't mentioned there.

Instead, I based the example I coded after the toy example mentioned in these slides (page 15).



The circuit is represented by a matrix of conductivities. What kind of structures might be present in a VLSI chip? The materials seeem to imply that they are dense, but since the actual conductivities are based on the design of chips to be modelled. Given a schematic for a VLSI chip, how do you construct a matrix?

Some other readings

https://www.mpi-magdeburg.mpg.de/2917420/lecture1-handout.pdf

- Model reduction is a topic that comes up frequently. The size of the VLSI matrix is so massive that it is only feasible to process it when it has been simplified
- It appears to be a linear system, but this is not explicitly verified in the slides.
- thermic/electro magnetic effects are what can disturb the signal; multilayered chips are a problem. How does this come into play when representing the system?
- Existing methods include Pade approximation, rational interpolation, and rational interpolation. How have these examples been constructed?

Problems/questions

- I haven't seen a resource that actually verifies that we're modelling the effects of a delta signal. The above picture from the stanford slides implies it, but only for a toy example

- What kind of circuits are represented? Just a network of resistors? How do I construct a matrix A such that it represents a realistic VLSI system that someone is interested in modelling in modern applications?

Irrelevant things

- https://link.springer.com/article/10.1007/BF02471131 seems like it's solving the exact opposite problem, using a VLSI chip to model a different dynamical system

Constructing the VLSI example: Advanced Model Order Reduction Techniques in VLSI design

- Again working with the dynamical system state space equations:

$$\begin{aligned} G\mathbf{x}(t) + C\dot{\mathbf{x}}(t) &= B\mathbf{u}(t) \\ \mathbf{y}(t) &= L^T\mathbf{x}(t) \end{aligned}$$

- G and C are $n \times n$ conductive and storage element matrices
- B, L are the $n \times N$ input and output positions matrices
- $B = L$ or $B = -L$ where N is the number of input or output ports
- $\mathbf{x}$ state variables can be nodal voltage or branch currents of linear circuits
- A incident matrices, g, c, l, v indicate conductive, capacitive, inductive, voltage source

$$G = \begin{bmatrix} A_g \mathcal{G} A_g^T & A_l A_v & \\ A_l^T & 0 & 0 \\ A_v^T & 0 & 0 \end{bmatrix} \quad C = \begin{bmatrix} A_c \mathcal{C} A_c^T & 0 & 0 \\ 0 & -\mathcal{L} & 0 \\ 0 & 0 & 0 \end{bmatrix} \quad \mathbf{x} = \begin{bmatrix} \mathbf{x}_n \\ \mathbf{x}_l \\ \mathbf{x}_v \end{bmatrix}$$

G and C are symmetric psd. We can rewrite the equation as below:

$$G = \begin{bmatrix} G_{11} & G_{12} \\ G_{12}^T & 0 \end{bmatrix} \quad C = \begin{bmatrix} C_{11} & 0 \\ 0 & -C_{22} \end{bmatrix} \quad \mathbf{x} = \begin{bmatrix} \mathrm{x}_1 \\ \mathrm{x}_2 \end{bmatrix}$$