Re: Graphs and reducibility(or something like that)

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- *From*: "Jon Slaughter" <Jon_Slaughter@xxxxxxxxxxx>
- *Date*: Sat, 21 Jul 2007 05:36:57 GMT

"Proginoskes" <CCHeckman@xxxxxxxxx> wrote in message
news:1184985789.069875.300990@xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

> On Jul 20, 6:49 pm, "Jon Slaughter" <Jon_Slaugh...@xxxxxxxxxxx> wrote:
>
>> I'm trying to simplify a network of electrical components and I'm curious
>> if
>> theres any way to do this.
>>
>> The network is equivalent to a graph but each edge consists has a
>> "weight"
>> to it that is a function. Every edge has a similar function that "looks"
>> the
>> same. Some nodes are known values while others are not.
>>
>> The function is actually a linear differential equation with constant
>> coefficients.
>>
>> For example, I might have something like
>>
>> +
>> /\
>> Z2 Z3
>> / \
>> +−−Z1−−+
>>
>> Where Z1, Z2, Z3 are differential equations.
>>
>> In reality the graph is equivalent to a system of differential equations
>> and
>> there are unknowns that exist which each branch and/or at some nodes.
>>
>> I can convert the differential equations into algebraic equations by
>> taking
>> the laplacian as one method but it still involves solving a large system.
>>
>> I'm more interested in using the fact that each edge/branch is identical
>> to

every other one except for some basic constants.

In essence I think I can treat each branch with a weight as a vector
where
the elements of the vector are the coefficients of the DE.

so for example, I might have as a function L(t;....) = c*dV1/dt + a*V2 −
b*V3

and so I could treat that as a vector like (a,−b,c). Every branch will
just
have different coefficients in the function L but all of the same "form".
I
feel that I could somehow use this to my advantage at simplifying the
graph/system. (Although I think the size of the vector grows
exponentially
based on the size of the graph)

Is there anything I can do to simplify my problem? Maybe there are some
results in graph theory(I think this is where the problem comes from)
that
can help? I'm actually wondering if there is some recursive way to
simplify
the elements. Most of the "vectors" will only have non−zero elements for
those that represent coefficients around its branch.

In any case just looking for some ideas,

But where are you using the fact that you have a graph? How does the
edge uv related to the vertex u, for instance? And what kind of
structure do you have? For instance, do the differential equations
along a cycle satisfy some law like Kirchoff's?

I don't have a graph?

http://en.wikipedia.org/wiki/Glossary_of_graph_theory

A graph is just a set of verticies and edges which some relation that maps
pairs of verticies to edges? If thats the case then I definitely have a
graph.

In any case, when I have all these weights there is an operation to combine
them in a specific way.

Suppose

W(Ni,Nj) is the "weight" of the edge NiNj which, for this problem, is generally some linear differential equation.

Then we know that

sum(I(W(Ni,Nj)),j \in Q) = 0

This is kirchoffs current law which just says that the sum of the currents entering a node is 0. I is a "function" that maps the weight into its equivilent current and Q is the set of indecies for nodes that are adjacient to Ni.

We also would have something like

V(Ni) − sum(V(Nj),j \in Q) = 0

where V maps a node to a voltage and Q is an ordered closed list of adjacient nodes. This would be kirchoffs voltage low.

(I'm kinda making up those equations as I go so they might not be totally right)

But I think the main point here is that what I ultimately have is just weights that are differential equations and inside those equations I have all the info about the electronic aspect of the graph but abstractly its just a graph with weights and I should be able to simplify it.

Whats really going on is that I have the weight function W(Ni,Nj) = (V(t,Ni) − V(t,Nj))/Z_NiNj(t,N1,...,Nn;a1..am)

And you can think of this as ohms law. It essentially defines a current on the edge NiNj. Then of course I must have sum(W(Ni,Nj)) = 0 for all Nj with common vertext Ni. This is kirchoffs current law.

Maybe I'm starting not to make sense though. The idea is simply to generalize the case for resistors.

if I have some graph of resistors then what I really have is a linear algebraic system of equation. Each edge creates an equation. The system is related to the graph. Change the graph and change the system.

Infact what we have is V(Ni) − V(Nj) − RNiNj*INiNj = 0 for each edge and sum(NiNj) = 0 for each node Ni where the sum is over adjacient nodes to Ni.

It seems I end up having to have an extra structure though that exists on the graph. Maybe I need to think it out a little more.

Thanks,
Jon

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