Oral Discussions on Session: "Optimization and DSM" – Part II

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Abstract

This paper contains the second part of the transcribed oral discussions of Session "Optimization and DSM" of the 2013 IREP Symposium-Bulk Power System Dynamics and Control, held on Wednesday afternoon, August 28, 2013. Papers [1]-[3] were presented.

Discussion

Chair: The floor is open for questions. No questions, no dinner!

Anurag Srivastava (Washington State University): The question is for the second presenter [2] and your assumption about power trajectory prediction. How do we get the power trajectory?

Maryam Kamgarpour (ETH Zurich): Could you please repeat the question?

A. Srivastava: You presented three methods; I think second method was using the power trajectory prediction.

M. Kamgarpour: It was using the historical power consumption and then using that data to see what is a feasible power trajectory.

A. Srivastava: But basically you are trying to fit your load to meet the power trajectory, right?

M. Kamgarpour: Yes.

A. Srivastava: So that power trajectory was before demand response or after demand response?

M.Kamgarpour: This was just an arbitrary potential trajectory to follow. It was just a given trajectory to follow.

A. Srivastava: So there is a question of how do we get that original trajectory?

M. Kamgarpour: OK. One possibility is that you get that from the system operator as a power trajectory, because of, for example, renewable generation variations, or forecast uncertainty and you may get some power trajectory you need to follow.

A. Srivastava: Thanks.

George Gross (University of Illinois): My question to all the presenters is the following. I live in a house with three women, my wife and my two daughters, and I used to be a utility executive and they still think I am a utility executive; they don't like to turn off the light after they are leaving the room and so forth. And I want to know what kind of motivation are we going to give to individual users to be responding to the kind of signals we want to see them do, given that we are using this optimal control theory or game theory type of techniques.

Chair: It could be for any of the panelists.

G. Gross: It's for all three panelists. I want to get as many opinions as possible.

Chair: Whoever wants to go first, go.

Renato Procopio (University of Genoa): In my case it's quite simple because the SPM is owned by the same entity who owns also the control, so it's our interest to plan in an optimal way and to manage in an optimal way the grid. So it's only one subject, who owns and manages the whole grid; so it's basically our own interest.

G. Gross: You have only one customer?

R. Procopio: Yes, only one.

Chair: The other panelists?

M. Kamgarpour: In my case I guess it is more difficult because one option will be monetary incentives. We have to see how much actual monetary incentives we could offer to each household for such participation, which is something we are exploring now, but we are looking at different options, for example, if the money, for example from arbitrage making is not sufficient enough to moti-

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vate, perhaps there could be some lottery schemes, something like that…

G. Gross: They don't pay attention to the telephone schemes which reduce money up to 7:00 at night. So money is not necessarily going to be an incentive.

Archie Chapman (University of Sydney): There are other incentives you can apply, other signals you could send, other than monetary incentives. Just things like, I mean economists and psychologists have been looking at simple things, like globes which glow different colors depending on what the carbon intensity of your current energy uses in your house at particular times of the day. They are simple signals that prompt them to turn the lights off when they leave the room. But in terms of a more systemic approach, things like time-of-use pricing tariff structures probably, the simplest but still fairly effective way of going.

Ian Hiskens (University of Michigan): So, first a comment to Archie [1]. Guilty as charged! I just thought that everyone told the truth, actually...

(Laughter)

I. Hiskens: But more seriously, a comment following up from George Gross. So when people are using cell phones, no one is taking notice of the fact that there is load scheduling that is going on all the time, with packets being rescheduled. And they just accept that as being normal. I guess what we envisage is a similar type of strategy for air conditioning or charging plug-in electric vehicles or running pool pumps. As a consumer you don't really care if the energy is being consumed now or a little bit later as long as it meets some criteria that you have established. For example, with an electric vehicle that it's charged for a certain time and with the air conditioning that the temperature is about what you set it to. If the utility is sending signals for interrupting the air conditioning in a way that doesn't really affect you, what do you care?

Chair: That was a comment, no need for response from the panel.

Elizabeth Ratnam (University of Newcastle): A comment in response to the time-of-use pricing. I worked for a utility and we did quite a lot of studies with time-of-use pricing and we found that after a couple of months, customers no longer responded to high pricing signals. At the time maybe we didn't price it enough for them to care?

G. Gross: That was 20 years ago…

Chair: Another comment, OK. Is there a need to reply? We appreciate the comments. Shmuel, you get the microphone now.

Shmuel Oren (UC Berkeley): I want to make a comment regarding the first presentation [1]. I think that the problems that you illustrate, with the assumptions and all that, is more a reflection on the fact that you are looking at demand response in a too granular fashion. I mean the idea that you control devices and every device will have a comfort function or utility function of some sort to respond, I think it's dead on arrival. When you go to residential level, I think the role of the aggregator is basically to convert retail products, which are going to be offered as a quality differentiated service, to a wholesale product that is going to be usable by the system operator. Trying to paddle electricity as a commodity at a residential level, I think it is a ridiculous idea and, you know, people have talked about that in the '80s and it never went anywhere. So a lot of the problems that you describe go away if you define, for example, a much less granular product, like for example 3-level fuse size, that you can interrupt with a certain frequency, and treat it as a quality of service differentiation and then use efficient rationing, which is part of mechanism design to price those and then somehow you have to tie it into what that's going to be worth in the wholesale market when you aggregate a lot of interruptible contracts like that on a large population. And let the consumers figure out when they get the signal that they are going to be interrupted, to have the fuse size, have all the Zigbee devices there and automate whether the one day they want to watch football, the other day they want to wash their dishes. So we don't have to get down to the device level, I mean, we are doing it in economics all the time, you know. When you talk about the theory of the firm, the firm has a cost function that reflects all the optimization and all the reallocation and inventory decisions that the firm is making behind closed doors, but what they project to the outside world is one cost function and we are treating that as the basic quantity and we are optimizing and we are running markets based on that. So we can do it by asking consumers basically to present a supply function for interruptible kilowatts access to their household and then figure out what to do with that.

A. Chapman: Sure, exactly. The point is, and you said it yourself, that you still have to set up a mechanism, which elicits this information appropriately, and that might be a 3-level separation of the electricity commodity. But you still have to set up the incentives appropriately. And the second point would be: OK, don't look at the residences. Look at the next level up: The interaction between the aggregator and some network operator. Why necessarily would the actions of the aggregator match perfectly with those of the network operator? There is no reason why they do, unless they have certain incentives aligned ap-

propriately. And if a network operator is asking entities outside of its control to implement parts of its own algorithms in a decentralized fashion, you have to take this into account because there is no reason why they will implement what they say they will. And this will happen as soon as you have different ownership of parts of the network, this will happen in all ways. The paper is basically an example built out of residential demand response, but there is no reason why the same problems can't arise up the network, as you have different ownership.

Chair: But I think on the comment that Shmuel Oren made, if I would have made a question would be that there are other ways of designing this program. One of them is the maximum interruptibility level, that you can vary, and you could elaborate on that.

A. Chapman: Yes, OK

Chair: But it is a different concept from the micro-control... I am going to let probably three more questions and then we need to wrap it up.

Dionysis Aliprantis (Purdue University): I think George Gross alluded to this, but he did not make it crystal clear, so I wanted to ask, and I think this is probably for the second presentation from Maryam [2]. In the context of thermostatically controlled loads, like the air conditioning, I thought from what I saw that you optimize, trying to minimize the cost, but perhaps it might be interesting to incorporate the comfort in there, so as to look at the tradeoffs of comfort vs. cost. Because, for example, I might not want to give up all my comfort just to minimize my daily AC cost. I am OK to have, you know, some kind of trade-off function, whatever you want to call it, so have you looked into that? What are your thoughts about it?

M. Kamgarpour: OK, that's a good point. In terms of not wanting to give up comfort, I guess the one control method we looked at, is non-disruptive, so basically the device is still operating within the temperature deadband that you are setting. So you are not really disrupting the comfort. But if then they are willing to give up some comfort, maybe for making a lower price that also could be formulated maybe by changing the setpoints. I think it could be added as…

D. Aliprantis: I don't think comfort is a deadband. You have a very slight deviation of half a degree and you feel less comfortable immediately, clearly it's not a deadband. At least for me and perhaps other people too.

Chair: I can tell you what I did when I was in the interruptible program of Madison Gas and Electric. On hot days I would set my thermostat in the morning to about 14 degrees centigrade and then when they interrupted I was comfortable for the rest of the day.

(Laughter)

Chair: There was another question in the back. And then one more after that, if there is. There may not be any.

Gianfranco Chicco (Politecnico di Torino): I have also a question for the paper on thermostatically controlled loads [2]. The focus is on changing the setpoint. The behavior actually depends on the difference between the temperature you are setting and the ambient temperature. And there is also an effect of the voltage. If you are considering what happens during the day, how did you take into account the effects of voltage and of the variation of the ambient temperature? I mean the one you can use as a reference. Thank you.

M. Kamgarpour: If I understand correctly, basically you are asking a question about the model. Yes, you can have higher-order models which also consider the capacitance in the walls and temperature evolution. So, that's something we are exploring. So, maybe that's a more accurate representation of the history…

G. Chicco: Just a very quick follow-up. So, in this case what you are considering as direct aggregation is the approximated model. In this case, is the computation burden of using a couple of hundreds of these objects so intractable as to need other techniques? Normally, with this kind of model it should be very quick to solve the problem in a reasonable time step...

M. Kamgarpour: Basically we are using a high-order model for the individuals and if the computation would be much more. Is that the question?

G. Chicco: The question is: is the computational time for running your simulation prohibitive? Because the execution for a couple of hundreds of objects with the kind of model you are using should be very fast.

M. Kamgarpour: Yes, some of the models, for example Markov Chain or the thermal battery model, are fast. Because it's independent of the number of TCLs actually.

Chair: Thank you very much. I would like to thank the presenters and thank the audience for being such good audience. I counted the same number here as in the beginning. You are still all here

(Laughter).

Chair: I think it's time for dinner. Thank you all.

References

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[3] A. Bonfiglio, L. Barillari, M. Brignone, F. Delfino, F. Pampararo, R. Procopio, M. Rossi, S. Bracco and M. Robba, "An Optimization Algorithm for the Operation Planning of the University of Genoa Smart Polygeneration Microgrid," Bulk Power Systems Dynamics and Control – IX (IREP), August 25-30, 2013, Rethymnon, Crete, Greece