Typical ADMM consensus problem:

Want to solve in a decentralized way.

Simplified formulation since :

Centralized WLS state estimation (non-convex function since h(x) is nonlinear, Gauss-Newton doesn’t guarantee convergence – not even local convergence like in Newton’s method):

Decentralized WLS state estimation using ADMM for partition *i* (non-convex for which ADMM does not guarantee convergence):

Recall:

Back to the decentralized WLS formulation:

Using the Gauss-Newton method, expand the nonlinear function into its Taylor series around , neglecting the higher-order terms.

Neglecting the second-derivative terms,

Polar AC power flow:

Rectangular AC power flow:

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Derive rectangular line flow:

In order for ADMM to converge, all of the areas should be referenced to one slack bus. Otherwise the averaging process won’t converge.

Assume there exists two arbitrary areas A and B. Each area has its own slack bus, slack a and slack b. Assume slack a is the global reference bus. How do you reference area B’s slack bus to area A’s slack bus?

1. Run SE for Area A, and run SE for Area B.
2. Look at the common buses (overlapped boundary buses) between Areas A and B. Take th\_a – th\_b for those overlapped buses, and take the average (in general, there should only be a few tielines).
3. Add that average to all of the angles for Area B. That’s very straightforward in polar form. But how do you do that in rectangular form?

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The voltage for any bus in Area A is . The voltage for any bus in Area B is

To change the reference bus for all of the buses in Area B, the new voltage would be

Current D-MASE process:

1. Area 1-4 does its own small SE.
2. They exchange their boundary estimates, take the average, and use that average to calculate their next step.

The problem is that they can never converge, because each area has its own slack bus.

New D-MASE process:

1. Area 1-4 does its own small SE.
2. Assuming Area 1 has the global reference (slack) bus, adjust Areas 2-4 so that they are all referenced to Area 1’s slack.
3. Then exchange boundary estimates, take the average, and use that average to calculate their next step.
4. Do you need to adjust it back to each area’s slack?