

# Why Are My Line Constants Capacitance Values Off?

From OpenDSSWiki

## Question

I can't match the value that OpenDSS computes for C0 when defining a LineGeometry model.

## Answer

Prior to August 17, 2011, there was a **BUG** in the LineConstants.Pas module! I know it is hard to believe, but there was. Through diligent efforts, Drs. Sarika and Jignesh Solanki at WVU discovered the discrepancy. Subsequent investigation revealed that the Kron reduction was applied to the nodal C matrix at the same time that the series Z matrix was reduced. While that seemed like a good idea at the time, it is incorrect.

The Kron reduction is often applied to line Z matrices to eliminate neutral conductors, static wires, etc. that modelers don't really care about. This is common practice for many types of analysis. The assumption is that these wires are connected to the system voltage reference so that their voltage in the  $V=ZI$  equation is zero. Therefore, you can eliminate the row and column from the Z matrix associated with such a wire using the Kron procedure. (See just about any modern power system analysis textbook if you don't know about the Kron reduction.)

The OpenDSS builds the shunt C matrix in nodal admittance form using the standard method of *images*. In terms of admittances, the equation is of the form  $I = YcV$ . When a Kron reduction is performed on Yc, the assumption is that the current into the designated neutral wire(s) is zero. This implies that the connection from the capacitances from phase to the neutral wires are open-circuited. The end result is that the equivalent zero-sequence capacitance of the line comes out less than it should be. It still has the capacitance to ground, but not the capacitance to neutral.

The computed positive sequence capacitance should be OK.

If the line definition was not reduced, and the neutral(s) modeled explicitly, the calculation was correct.

The other places in OpenDSS where a Kron reduction was performed were done correctly. This includes LineCode objects and CableConstants.

If the reduction were performed on the inverse of the nodal C matrix, it would have been correct. The correction that was applied to the LineConstants module was to make the reduction process the same as in the CableConstants modules.

This is not an issue if:

1. You never modeled any long overhead distribution lines where there was enough capacitance to matter.
2. Line capacitance is swamped by power factor correction or underground cable capacitance.

3. You did not reduce the Line model.
4. Your power flow simulations were predominantly balanced (or positive sequence).
5. You never used LineGeometry.

If you are using an older version of the program (prior to 17 Aug; or version 7.4.2 build 148.) it would be a good time to update.

--Rdugan 21:09, 18 August 2011 (UTC)

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