Back to driving point $Z$ for center feed dynamics.

\[ \text{MOM} \rightarrow Z, \text{direct}, \text{to some approximation.} \]

\[ \begin{array}{cccccc}
1 & 2 & 1 & \cdots & N & 1 \\
0 & & & & & \\
\end{array} \]

Would think, initially, that accuracy could/can be improved indefinitely by increasing $N$, the number of sub-intervals. This does not work. Why? For a given $a/A$, center current approximation to $\int k_3(\phi, \phi') d\phi d\phi'$ breaks down.
... 

Alternatives?

(1) Use a better approximation or just use integral above directly in Moos.

(2) Do a bit more analysis to understand input current better before beginning to compute.

Follow (2) - "Self-Inductance from Induced EMF."

Synonym for "Driving Point Z"
There are a couple of ways to derive the needed formula—we take the more straightforward of the two.

Apply Poynting's theorem to the geometry of the diode model from earlier.

\[
\frac{1}{2} \mathbf{I}(0) \mathbf{E}^*(0) \cdot \mathbf{Z}_{in} = -\frac{1}{2} \int_{\text{Surface}} \mathbf{E} \times \mathbf{H^*} \cdot d\mathbf{s}
\]

We will ignore power flow across end caps. Then,
\[ |I(0)|^2 Z_{in} = \int_{-\ell/2}^{\ell/2} \int_0^{2\pi} E_3(q, \bar{3}') H_{\varphi}(q, \bar{3}') a d\varphi d_3' \]

\[ = - \int_{-\ell/2}^{\ell/2} E_3(q, \bar{3}') I_{3'}^{*}(\bar{3}') d_3' \]

So
\[ Z_{in} = - \frac{1}{|I(0)|^2} \int_{-\ell/2}^{\ell/2} E_3(q, \bar{3}') I_{3'}^{*}(\bar{3}') d_3' \]

A peculiar result.
... Formula above shows \( I(0) \) in denominator. Could argue that if \( I(0) \) is known, then problem is solved since \( I(0) \) is numerically the same as \( yW \). Reasoning is that 1 volt \( \rightarrow \) terminal \( \rightarrow I(0) \).

Here reason differently...

Assume \( I(0) \), then compute \( E_z(a, z') \) that results from application of current source. \( I(3) \) can be "known" or assumed.
\[ E_{12} \text{ is then found by manipulating the expression above} - \]

\[ \text{Recall} \quad j \psi \in \mathcal{E}_3 (z, z') = \left( \frac{\partial^2}{\partial z^2} + k^2 \right) \int_{-\ell/2}^{\ell/2} \frac{e^{-jkr}}{4\pi r} \mathcal{I}(z') dz' \]

where \( r^2 = z^2 + (z - z')^2 \)

\[ \text{Define kernel function} \]

\[ \tilde{G}(z, z') = -\frac{1}{\omega 4\pi j \varepsilon_0 \left( \frac{2}{\partial z^2} + k^2 \right)} e^{-jk\varepsilon_0} \]

\[ \cdots \]
\[ E_3(a, z) = - \int_{-L/2}^{L/2} G(z, z') I(z') d z' \]

\[ E_{1N} = \frac{1}{|E(0)|^2} \int_{-L/2}^{L/2} \int_{-L/2}^{L/2} G(z, z') I(z) I^*(z') d z d z' \]

is a specific formula for \( E_{1N} \). This has been evaluated in various ways—see following for results.