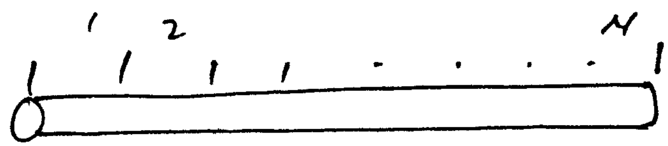
Back to Driving Point Z for Center fed Dipoles

MOM $\rightarrow$ Z_{IN} directly, to some approximation.



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

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Alternatives?

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

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

Follow (2) - "$\underbrace{\text{Self-Impedance}}_{\text{Synonym for "Driving Point Z"}}$ from Induced EMF."

There are a couple of ways to derive the needed formula — we take the more straightforward of the two.

Apply Poynting's Thm to the geometry of the dipole model from earlier

$$\frac{1}{2} I(0)\, I^*(0) \cdot Z_{IN} = -\frac{1}{2} \oint_{\text{surface}} \bar{E} \times H^* \cdot d\bar{s}$$

We will ignore power flow across end caps. Then,

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$$|I(0)|^2 Z_{IN} = -\int_{-\ell/2}^{\ell/2}\int_{0}^{2\pi} E_z(a,z')\, H_\phi^*(a,z')\, a\, d\phi\, dz'$$

$$= -\int_{-\ell/2}^{\ell/2} E_z(a,z')\, I^*(z')\, dz'$$

So $$Z_{IN} = -\frac{1}{|I(0)|^2}\int_{-\ell/2}^{\ell/2} E_z(a,z')\, I^*(z')\, dz'$$

A peculiar result.

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Formula above has $I(0)$ in denominator – could argue that if $I(0)$ is known, then problem is solved since $I(0)$ is numerically the same as Y_{IN}. Reasoning is that 1 volt → terminals → $I(0)$.

Here reason differently . .

Assume $I(0)$, then compute $E_z(a, z')$ that results from application of current source. $I(z)$ can be "known" or assumed.

Z_{LH} is then found by manipulating expressions above —

<u>Recall</u> $$j\omega\epsilon_0 E_z(a,z) = \left(\frac{d^2}{dz^2} + k^2\right) \int_{-\ell/2}^{\ell/2} \frac{e^{-jkr}}{4\pi r} I(z')\,dz'$$

where $r^2 = a^2 + (z-z')^2$

Define kernel function

$$\tilde{G}(z,z') = -\frac{1}{\omega 4\pi j \epsilon_0}\left(\frac{\partial^2}{\partial z^2} + k^2\right)\frac{e^{-jkr}}{r}$$

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$$E_z(a,z) = -\int_{-\ell/2}^{\ell/2} \tilde{G}(z,z')\, I(z')\, dz'$$

$$Z_{IN} = \frac{1}{|I(0)|^2} \int_{-\ell/2}^{\ell/2}\int_{-\ell/2}^{\ell/2} \tilde{G}(z,z')\, I(z)\, I^*(z')\, dz\, dz'$$

is a specific formula for Z_{IN}. This has been evaluated in various ways – see following for results.