

Corso di Laurea in Ingegneria Informatica, Biomedica e delle Telecomunicazioni

Corso di Campi Elettromagnetici
a.a. 2017-2018

14 Maggio 2018

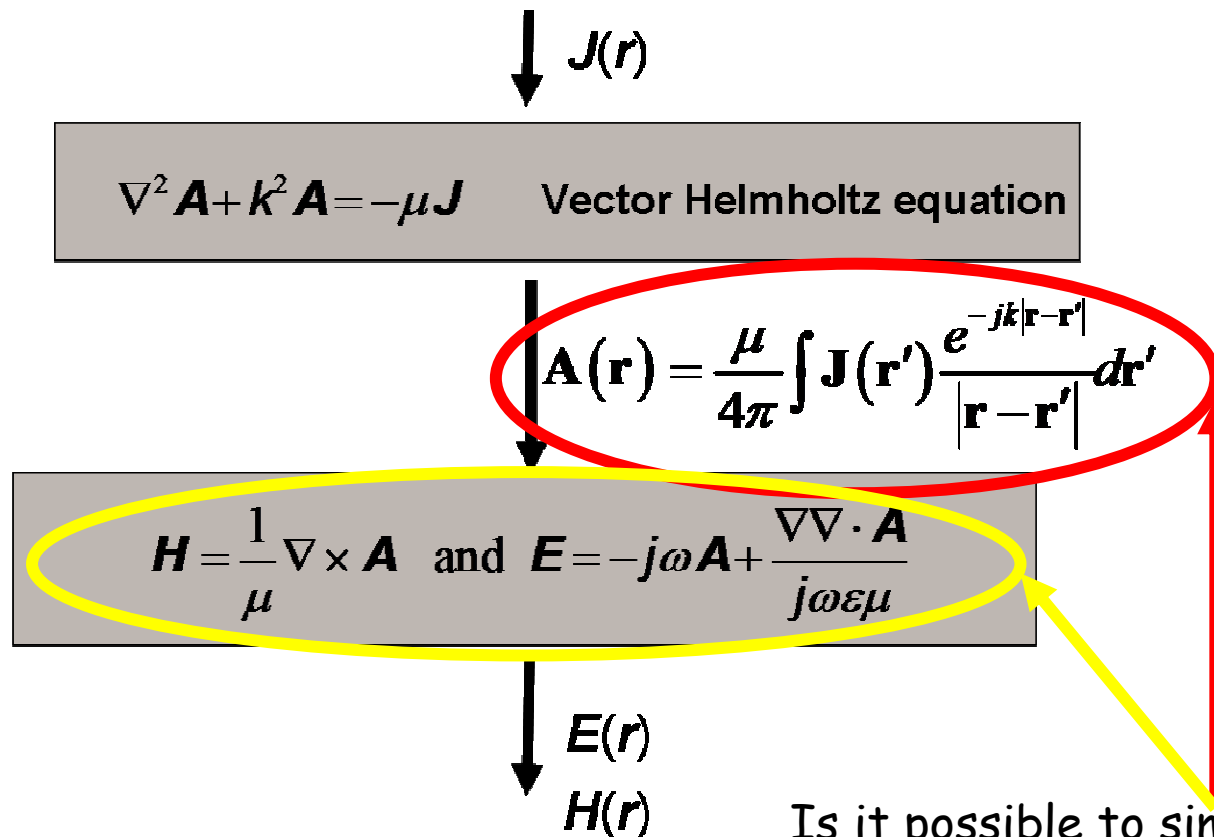
Extended Antennas

Outline

- Radiation problem for extended antennas
- Field regions



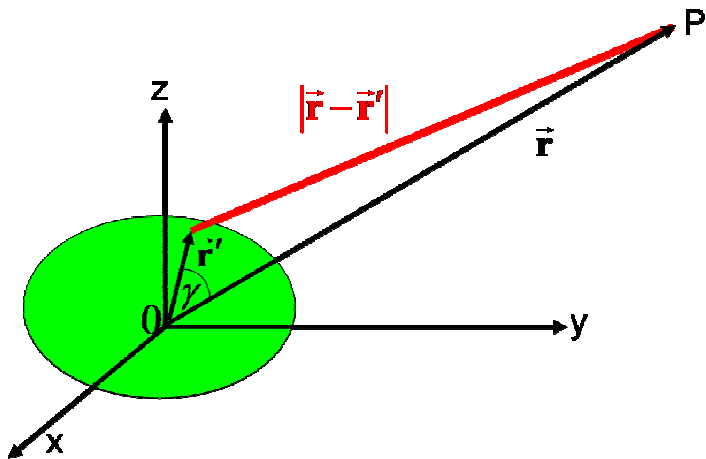
Extended antennas



Is it possible to simplify the expressions of the fields, possibly via proper approximation of the vector potential \mathbf{A} ?

Extended antennas

$$\mathbf{A}(\vec{\mathbf{r}}) = \frac{\mu}{4\pi} \int \mathbf{J}(\vec{\mathbf{r}}') \frac{e^{-j\beta|\vec{\mathbf{r}}-\vec{\mathbf{r}}'|}}{|\vec{\mathbf{r}}-\vec{\mathbf{r}}'|} d\vec{\mathbf{r}}' \quad |\vec{\mathbf{r}}-\vec{\mathbf{r}}'| = r - r' \cos \gamma + \frac{(r')^2}{2r} \sin^2 \gamma + \dots$$



$$\frac{1}{|\vec{\mathbf{r}}-\vec{\mathbf{r}}'|} = \frac{1}{r - r' \cos \gamma + \frac{(r')^2}{2r} \sin^2 \gamma \dots}$$

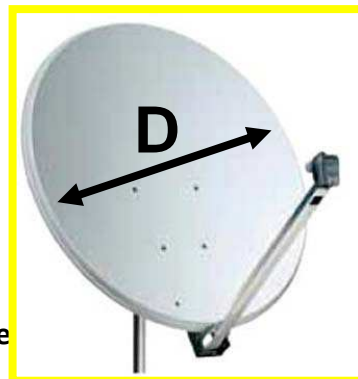
$$e^{-j\beta|\vec{\mathbf{r}}-\vec{\mathbf{r}}'|} = e^{-j\beta r} e^{j\beta r' \cos \gamma} e^{-j\beta \frac{(r')^2}{2r} \sin^2 \gamma} \dots$$

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$$\frac{1}{|\vec{\mathbf{r}}-\vec{\mathbf{r}}'|} = \frac{1}{r - r' \cos \gamma + \frac{(r')^2}{2r} \sin^2 \gamma + \dots} \approx \frac{1}{r} \quad \text{if } r' \ll r$$

$$e^{-j\beta|\vec{\mathbf{r}}-\vec{\mathbf{r}}'|} = e^{-j\beta r} e^{j\beta r' \cos \gamma} e^{-j\beta \frac{(r')^2}{2r} \sin^2 \gamma} \dots \approx e^{-j\beta r} \quad \text{if } r' \ll \lambda$$

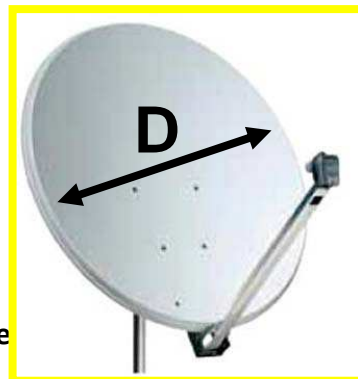


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When the antennas are small with respect to the wavelength and to the distance from the observation point

$$\frac{e^{-j\beta|\vec{\mathbf{r}}-\vec{\mathbf{r}}'|}}{|\vec{\mathbf{r}}-\vec{\mathbf{r}}'|} \approx \frac{e^{-j\beta r}}{r} \quad \longrightarrow \quad \mathbf{A}(\vec{\mathbf{r}}) \approx \frac{\mu}{4\pi} \frac{e^{-j\beta r}}{r} \int \mathbf{J}(\vec{\mathbf{r}}') d\vec{\mathbf{r}}'$$