Corso di "Antenne"

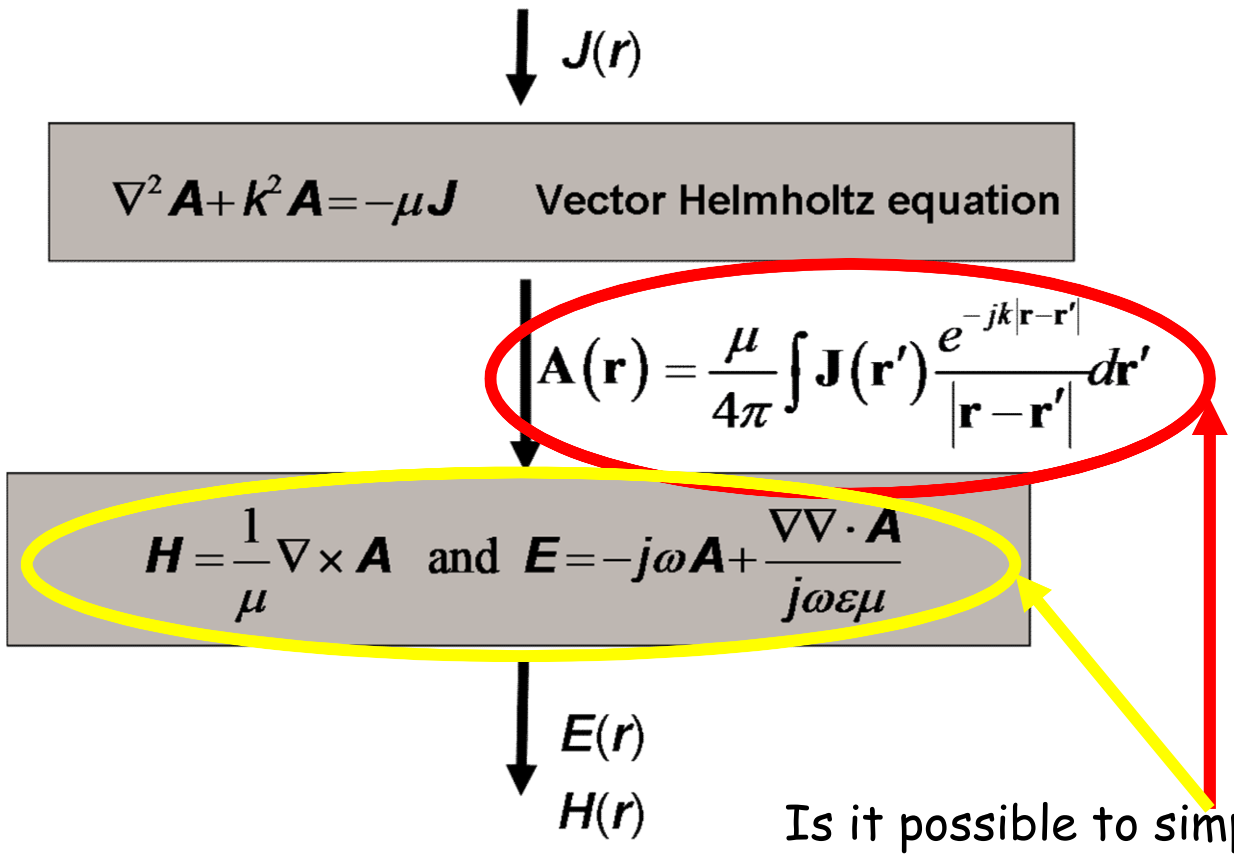
Corso di Laurea in Ingegneria Informatica, Biomedica e delle Telecomunicazioni

Università degli Studi di Napoli "Parthenope"

a.a. 2023-2024 - Laurea "Triennale" - Secondo semestre - Terzo anno

Prof. Stefano Perna

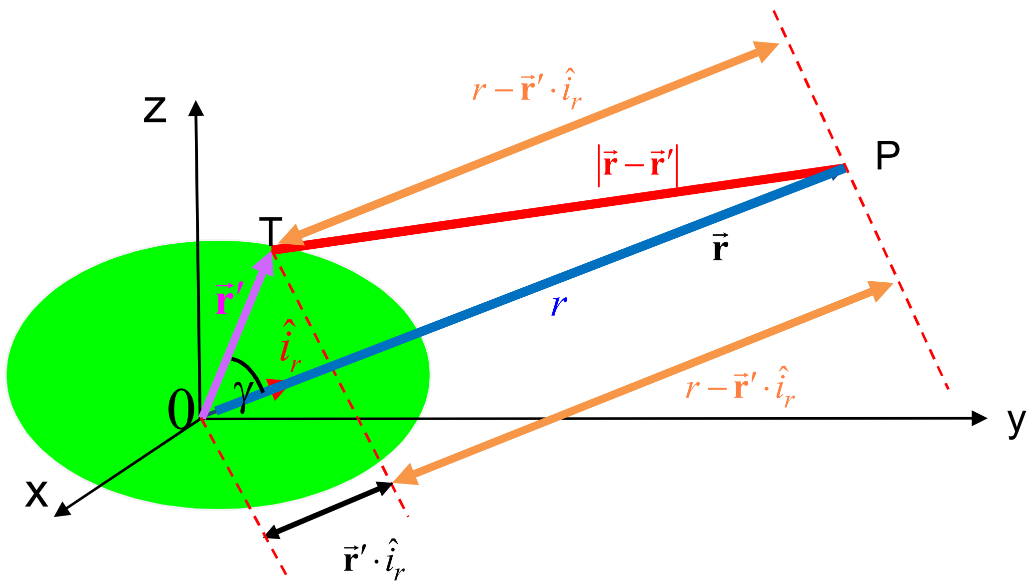
Extended antennas



Is it possible to simplify the expressions of the fields, possibly via proper approximation of the vector potential ***A***?

Fraunhofer region

$$|\vec{\mathbf{r}} - \vec{\mathbf{r}}'| \approx r - \vec{\mathbf{r}}' \cdot \hat{i}_r$$



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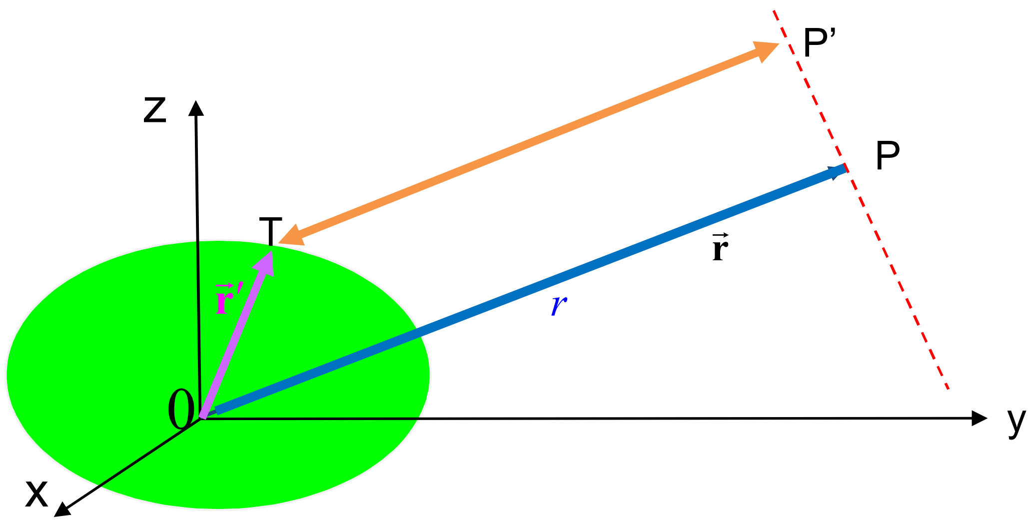

Fraunhofer region

$r >> D$

$r > \frac{2D^2}{\lambda}$

$r >> \lambda$

$$\begin{cases} \mathbf{E}(\vec{\mathbf{r}}) = \mathbf{E}(r, \vartheta, \varphi) = \frac{j\zeta I}{2\lambda} \frac{e^{-j\beta r}}{r} \mathbf{l}(\vartheta, \varphi) \\ \zeta \mathbf{H} = \hat{i}_r \times \mathbf{E} \end{cases}$$

$$\mathbf{l}(\vartheta, \varphi) = l_\vartheta(\vartheta, \varphi)\hat{i}_\vartheta + l_\varphi(\vartheta, \varphi)\hat{i}_\varphi$$

Effective length

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- the e.m. field propagates along $\hat{i}_r$
- the e.m. field lies on the plane orthogonal to the propagation direction
- |E| and |H| exhibit the decaying factor 1/r
- |E| and |H| are proportional through ζ

Fraunhofer region

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$$\Downarrow$$

$$\mathbf{S} = \frac{1}{2\zeta}|\mathbf{E}|^2\,\hat{i}_r$$

Field regions

- *Far-field (Fraunhofer) region* is defined as "that region of the field of an antenna where the angular field distribution is essentially independent of the distance from the antenna. The far-field region is commonly taken to exist at distances greater than $2D^2/\lambda$ from the antenna, λ being the wavelength".

- In this region, the field components are essentially transverse