ELETROMAGNETISMO II
Reflexão e Transmissão de Ondas

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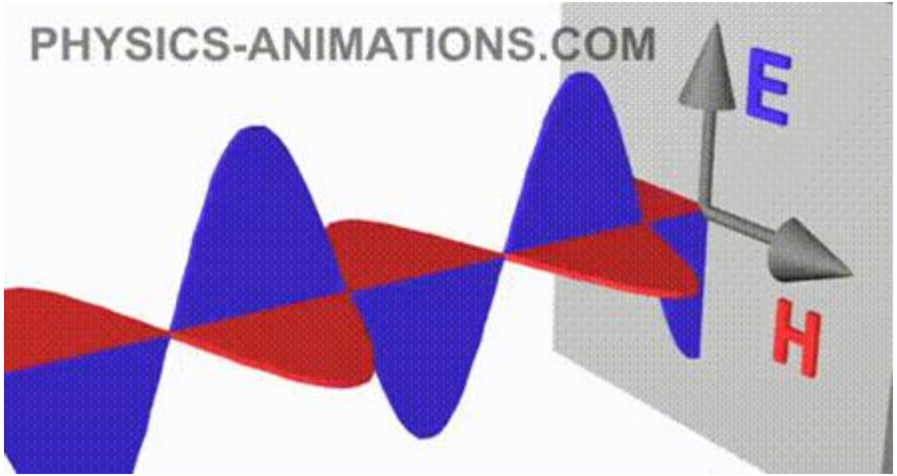
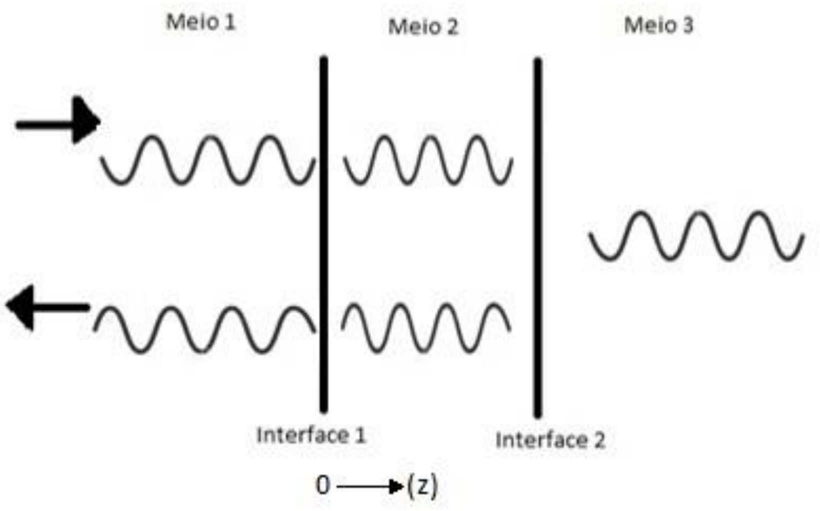
Introdução

Reflexão e transmissão de ondas eletromagnéticas



Explicação



$$E_1(z) = E_1^{+}.e^{-j\beta z} + E_1^{-}.e^{+j\beta z}$$

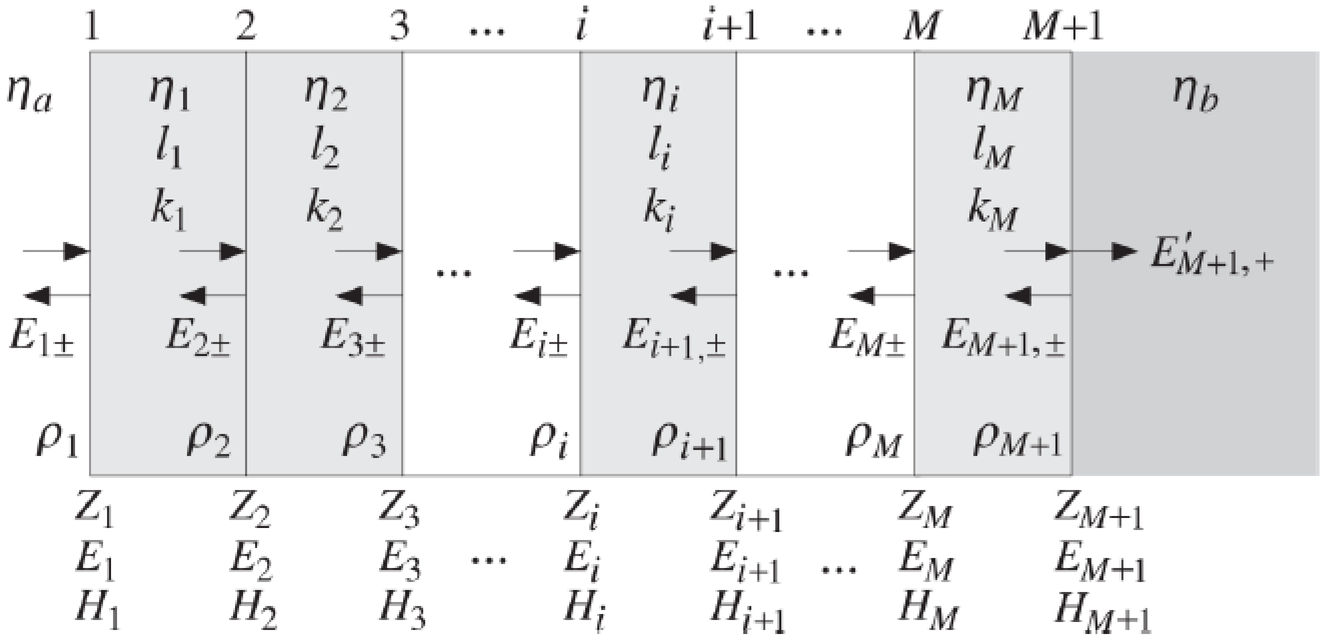
$$E_2(z) = E_2^{+}.e^{-j\beta z} + E_1^{-}.e^{+j\beta z}$$

$$E_3(z) = E_3^{+}.e^{-j\beta z}$$

$\Gamma = \frac{E_1^{-}}{E_1^{+}}$ Coef. de reflexão

$\mathrm{T} = \frac{E_3^{+}}{E_1^{+}}$ Coef. de transmissão

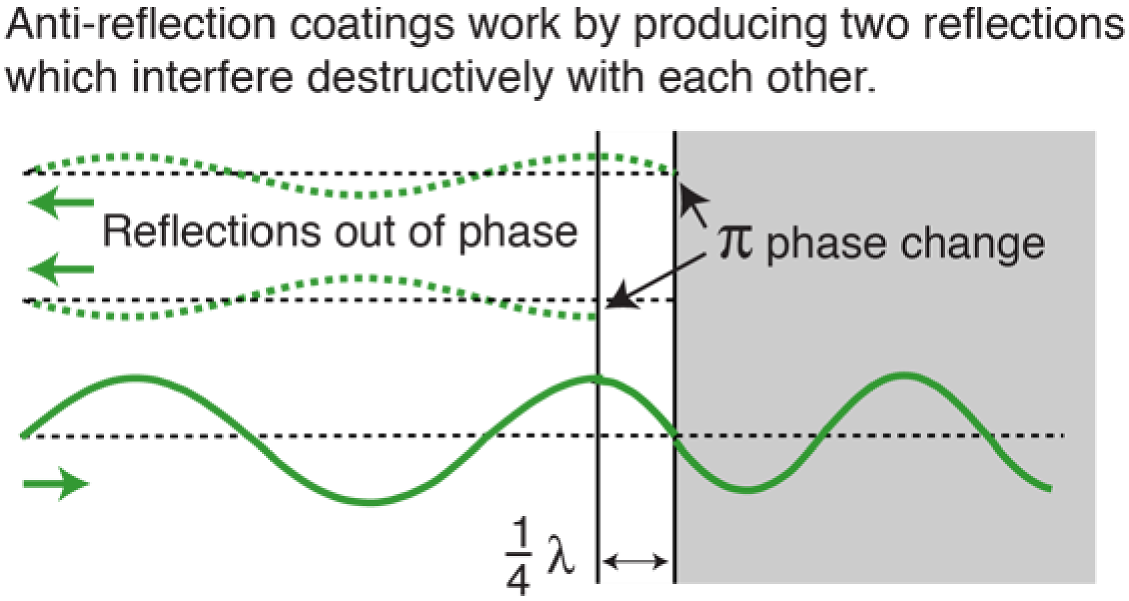
As setas mostram a direção das ondas nos meios em que variam com (z).



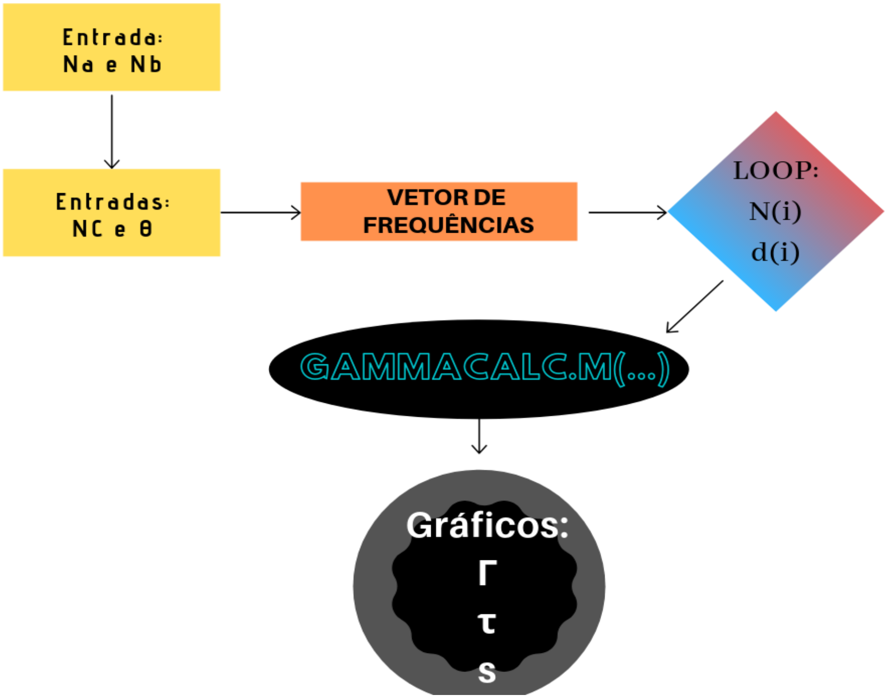
$$\boxed{\begin{pmatrix}E_{1+}\\ E_{1-}\end{pmatrix} = \mathbf{P}_1'\cdots\mathbf{P}_M'\frac{1}{\tau_{M+1}}\begin{pmatrix}1 & \rho_{M+1}\\ \rho_{M+1} & 1\end{pmatrix}\begin{pmatrix}E'_{M+1,+}\\ 0\end{pmatrix}}$$

$$\mathbf{P}_i' = \frac{1}{\tau_i}\begin{pmatrix}\mathrm{e}^{\mathrm{j}k_i\ell_i} & \rho_i\mathrm{e}^{-\mathrm{j}k_i\ell_i}\\ \rho_i\mathrm{e}^{\mathrm{j}k_i\ell_i} & \mathrm{e}^{-\mathrm{j}k_i\ell_i}\end{pmatrix}$$

Por que λ/4?


Anti-reflection coatings work by producing two reflections
which interfere destructively with each other.
Reflections out of phase
π phase change
1/4 λ

Demonstração do Programa



Gammacalc.m

```
function gamma = gammacalc(n,d,lambda,theta)
M = size(n,2)-2;                                              %
n1sen_2 = (n(1,1)*sind(theta))^2;                             %
c_i = sqrt(1 - n1sen_2 ./ n(1,:).^2);                         %
nt = n(1,:) .* c_i;                                           %
reflex = -diff(nt) ./ (2*nt(1:end-1) + diff(nt));             %
d = d .* c_i(1:M);                                            %
gamma = reflex(M+1) * ones(1,length(lambda));                 %
for i = M:-1:1                                                %
    B = 2*pi*d(i)./lambda;                                    %
    expz = exp(-2*1i*B);                                      %
    gamma = (reflex(i) + gamma.*expz) ./ (1 + reflex(i)*gamma.*expz);  %
end
```

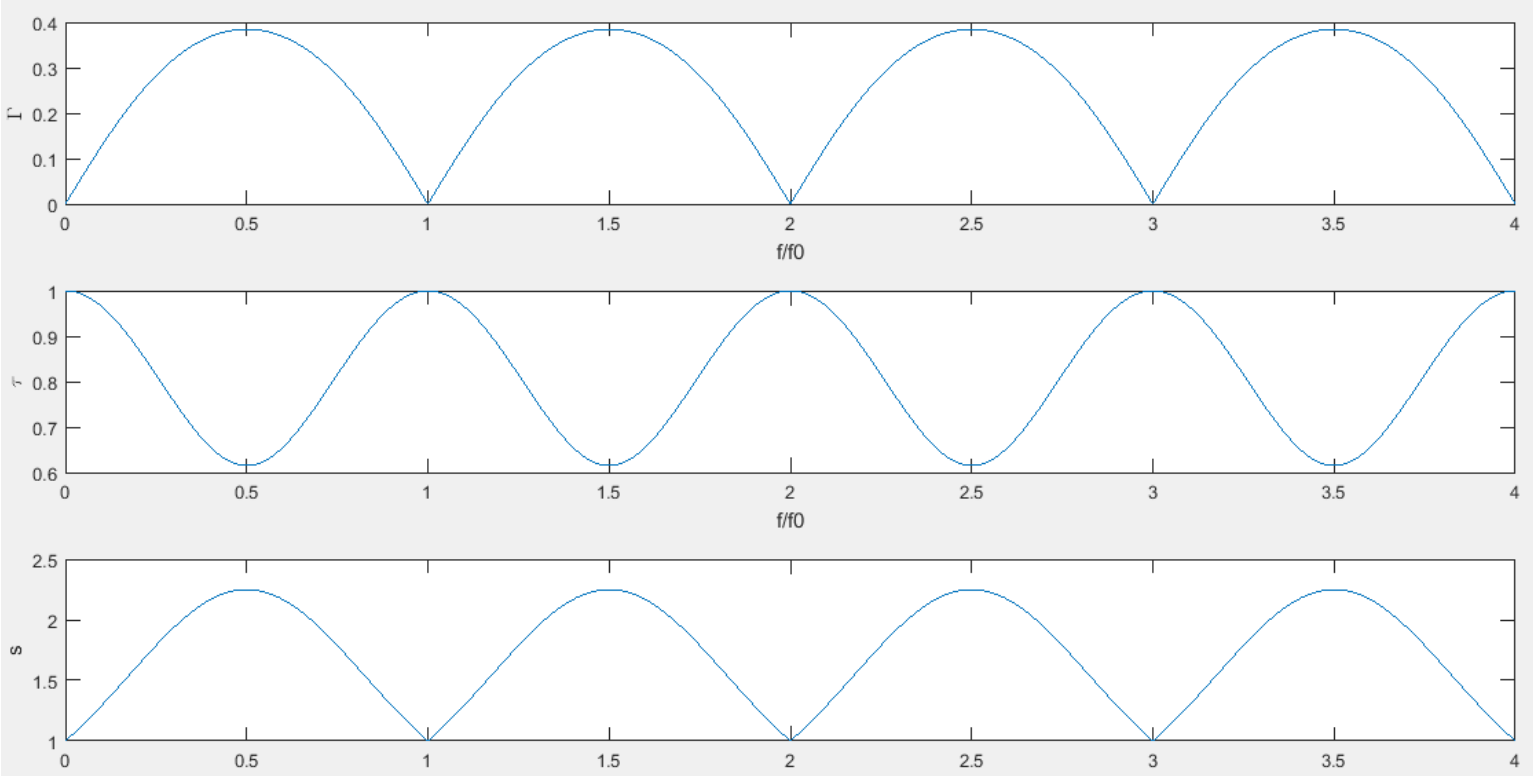
$$cos(\theta_i) = \sqrt{1 - \frac{n_a^2 sen\theta^2}{n_i^2}}$$

$$n_{Ti} = n_i cos\theta_i$$

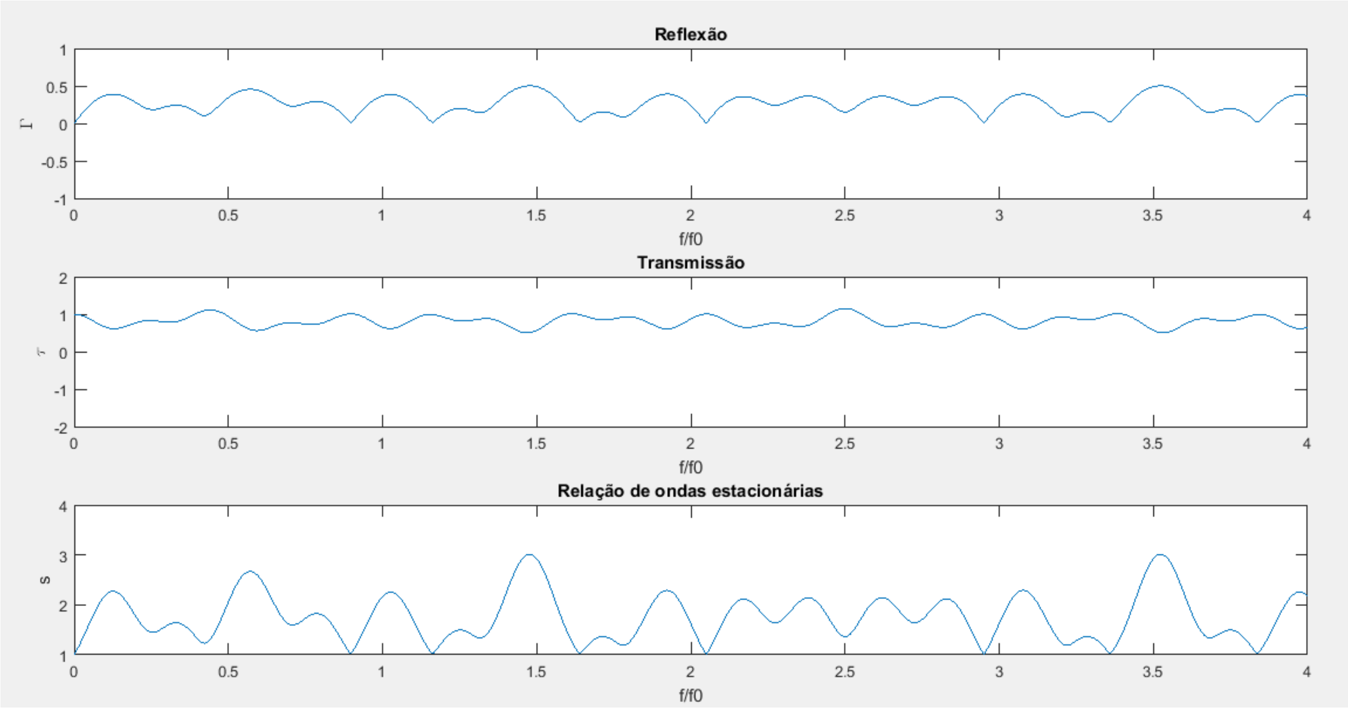
$$\eta_{Ti} = \frac{n_{T,i-1} - n_{Ti}}{n_{T,i-1} + n_{Ti}}$$

$$\Gamma_{Ti} = \frac{\eta_{Ti} + \Gamma_{T,i+1}e^{-2j\sigma_1}}{1 + \eta_{Ti}\Gamma_{T,i+1}e^{-2j\sigma_1}}$$

Exemplo - Incidência normal no vidro



Exemplo - Valores aleatórios



$N_a = N_b = 1$
$N_1 = 1,5;\ d_1 = 0,7;$
$N_2 = 1,75;\ d_2 = 0,5;$
$N_3 = 1,3;\ d_3 = 1;$

Referências Bibliográficas

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