Optickle

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Abstract

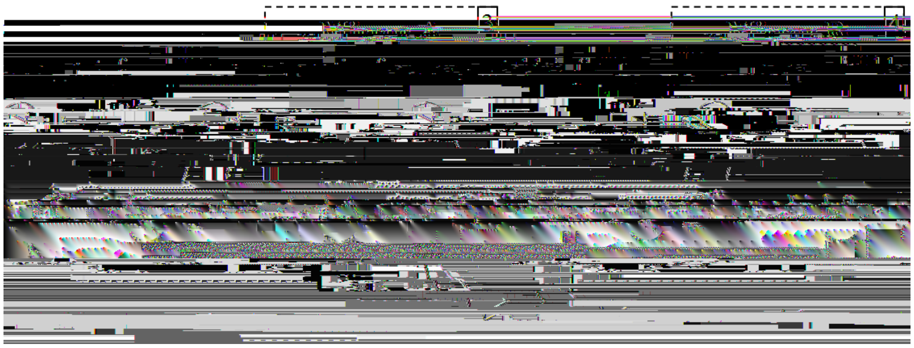

Figure 1: The example system: a Fabry-Perot cavity.

The source is responsible for illuminating the system. Let's assume that it generates a carrier and 2 RF sidebands from RF phase modu-

The output matrix, sending the field from the front of Mirror A to FEP 3 and from the back to FEP 2 is

$$\mathrm{M}_{out_3} = \begin{bmatrix} 0 & 0 \\ 0 & 1 \\ 1 & 0 \\ 0 & 0 \end{bmatrix}.$$

Finally, assuming that Mirror A has an amplitude transmission coefficient of t_A and an amplitude reflectivity of r_A (which may be complex),

$$\mathrm{M}_{opt_3} = \begin{bmatrix} -r_A & t_A \\ t_A & r_A \end{bmatrix}.$$

$$
M_{opt_3} = \begin{bmatrix}
i\, r_A & t_A & & & & \\
t_A & r_A & & & & \\
& & i\, r_A & t_A & & \\
& & t_A & r_A & & \\
& & & & i\, r_A & t_A \\
& & & & t_A & r_A
\end{bmatrix} :
$$

where a given excitation vector produces a vector of audio sideband fields are both associated with the same RF component. A not normally noteworthy feature of equation 13 is that the upper audio side-

4.3 Optic to Field Transfer Matrix

The optic to field matrix, much like the field to field matrix, must result in both upper and lower audio sidebands at FEPs, so it is constructed as

$$\mathbf{M}_{optic \rightarrow field} = \begin{pmatrix} \mathbf{M}_{\phi_-} \mathbf{M}_{gen} \\ \mathbf{M}^*_{\phi_+} \mathbf{M}^*_{gen} \end{pmatrix} \quad (18)$$

The matrix $\mathbf{M}_{gen}$ is composed of an optic specified matrix and DC fields. The DC fields are present as source fields which the optics modulate to produce audio SBs,

$$\mathbf{M}_{gen}(:, k_{n,m}) = \mathbf{M}_{drv_{n,m}} \mathbf{v}_{DC} \quad (19)$$

where $\mathbf{M}_{drv_{n,m}}$ is the modulation produced by driving optic n, degree of freedom m. The indices are $n \in 1 : N_{optic}$, $m \in 1 : N_{dof_n}$, and $k_{n,m}$ is the map of system degrees of freedom to optics internal degrees of freedom. $k_{n,m}$ is related to $\mathbf{M}_{DOF_n}$ from equation 14 by

$$\mathbf{M}_{DOF_n}(k_{n,m}, m) = 1 \quad (20)$$

with all other elements of $\mathbf{M}_{DOF_n} = 0$. This mapping is a bit ugly, but it can only be avoided by using higher dimensional tensors, which seem even less appealing.

The drive matrix $\mathbf{M}_{drv_{n,m}}$ can be written in terms of $\mathbf{M}_{opt_n}$

$$\mathbf{M}_{drv_{n,m}} = \mathbf{M}_{out_n} \frac{1}{2} \frac{\partial \mathbf{M}_{opt_n}}{\partial x_{n,m}} \mathbf{M}_{in_n} \quad (21)$$

4TnD[(n)-22510.32Tf60.68x[(¡)]TJ/F77.9724f5.67-1.63TD[(n;m)]TJ/F410.91T515.481.6n;m

5.2 AC Signals

AC signal computation follows a very similar path. The audio frequency signal present at a given FEP is

$$S_{AC} = \sum_{m=1}^{N_{RF}} \sum_{n=1}^{N_{RF}} (E^{*}_{DC_n} E_{-m} \delta_{n,m} + E_{DC_n} E^{*}_{+m} \delta_{m,n}). \tag{27}$$

The overall probe matrix is constructed from the individuals row at a time according to

$$\mathrm{M}_{prb}(k,:) = \begin{bmatrix} \left[\mathrm{M}_{prb_k} \mathrm{M}_{pin_k} \mathbf{v}^{*}_{DC} \right]^T & \left[\mathrm{M}_{pin_k} \right] \\ \mathrm{M}^T_{prb_k} \mathrm{M}_{pin_k} \mathbf{v}_{DC} & \mathrm{M}_{pin_k} \end{bmatrix}; \tag{28}$$

where $k \in$ 151T518TD[(7r:a)]T012.6626.95TD[(E)]TJ/F776.97Tf11.9-1.78obe.050TD[(2)]TJ/F2010
M_{prb_T}

8 Parting Example