Problem Statement

A system of equations and BC's governs the manner fluid oscillates in a 2D rectangular channel. Applying the Ritz method to these, we arrive at an algebraic eigenvalue problem:

$$\boldsymbol{M} + \lambda i \boldsymbol{\Phi} + \lambda^2 \boldsymbol{K} = \boldsymbol{0} \tag{1}$$

where $\boldsymbol{M}, \boldsymbol{\Phi}, \boldsymbol{K}$ are real constant $N \times N$ matrices. This problem admits analytic eigenvalues λ, the first few listed:

$$\lambda_{1,2,3} = \pm -2.4803 + 0.0173i, \pm 10.5719 + 0.1160i, \pm 22.2756 + 0.313425i \tag{2}$$

Another way to solve for the eigenvalues of (1) is to introduce a forcing term, which augments the system

$$\boldsymbol{M} + \omega i \boldsymbol{\Phi} + \omega^2 \boldsymbol{K} = \omega \boldsymbol{F}, \tag{3}$$

where F is a real constant $1 \times N$ vector. Note λ has been "changed" to the forcing frequency ω, a user selected parameter. Then (3) is not an eigenvalue problem, but rather a linear system of equations taking the form $\boldsymbol{A}x = \boldsymbol{b}$. Specifying a value ω yields a complex vector solution to (3), denoted C. Performing a frequency scan, we input several values of ω and plot the magnitude $|C|$, shown in figure 1.

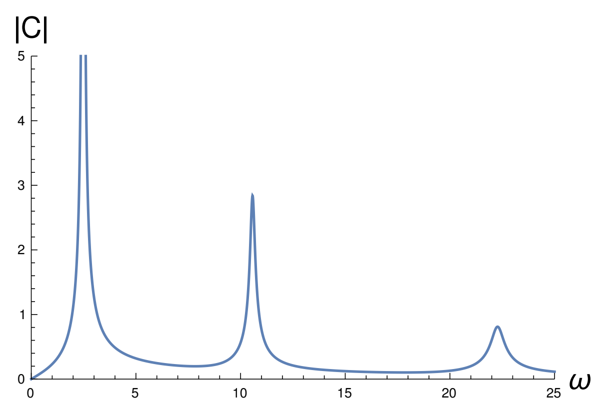

Figure 1: Response diagram corresponding to (3).

Denote ω_k the value corresponding to the k^{th} peaks of figure 1. We observe $|\lambda_1| = 2.4804 = \omega_1$, which in fact holds for all k. My question is: how can we separate ω_k into its real and imaginary components? I was told this is a fairly regular problem for people studying controls.