Perturbation of eigenvalues and the Newton polygon

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In several mathematical models arising from practical situations, such as frequency isolation problems or the passivation problem in Control Theory, one needs to modify the eigenvalues of a certain matrix or operator in a very specific way, either choosing the directions in which (some of) the perturbed eigenvalues should move, or choosing optimal perturbation directions in operator space so that the perturbed eigenvalues behave in some desirable way. Usually, the goal is to move the eigenvalues away from some 'dangerous' region (say, a resonance band, or a stability boundary). In some cases there is an additional restriction of structure preservation: if the unperturbed operator has some physically meaningful special structure (think of symmetries, for instance), then it makes sense to restrict the perturbed operator to have that same structure as well.

The goal of this talk is to give an idea of the basic mathematical tools that may be used to deal with such problems, paying special attention to the Newton polygon, a geometric construction which is fundamental to obtain asymptotic expansions of (and, therefore, valuable directional information on) the perturbed eigenvalues.