Summery of ACFlowSensitivity

Kaiwen Jin

HKUST-GZ

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Only consider fermionic system.

The real Green's function is: $\mathcal{G}$

The measure Green's function on the imag axis is: $G = [G_1, .., G_N]$

Denote the reconstructed Green's function as: $\tilde{\mathcal{G}}$. And denote $\tilde{G} = \left[\tilde{G}_1, .., \tilde{G}_N\right] = \left[\tilde{\mathcal{G}}(iw_1), .., \tilde{\mathcal{G}}(iw_N)\right]$.

The real spectrum is: $\mathcal{A}$

The date of the spectrum we calculate on the output mesh: $A = [A_1, .., A_M]$

Denote the reconstructed spectrum as: $\tilde{\mathcal{A}}$.

Methods Summary

1. Mathematical method: Barycentric Rational Approximation (AAA + prony denoise), Nevanlinna
2. Maximal Entropy Method. According to parameters choosing: Historic Algorithm, Classic Algorithm, Chi2kink Algorithm, Bryan Algorithm (average).
3. Stochastic method.

Generate some spectrum with MC(SA) method

$$A(w) = \sum_j \frac{\gamma_j}{w - p_j}$$

$$P(C \to C') = \exp(-\alpha(\chi^2(C') - \chi^2(C)))$$

And average them.

Methods Summary

(1) How choose the inverse temperature $(\alpha, \frac{1}{\theta})$ of Simulated Annealing: choose a good α (chi2kink, chi2min), take average

(2) How average measure spectrum: average all measured spectrums, average good spectrums, average spectrums with weights

(3) Sample what type of spectrums: $A(w)$ (better for delta type), $n(x)$ (better for smooth type)

Methods Summary

Method	Inverse temp	Ave Spec	Sample Obj
ssk(Sandvik)	a good	ave all	A(w)
sac(Beach)	ave all	weights	n(x)
som	❌	all good	A(w)
spx	a good	ave all	A(w)

Methods Compare

Method	cont	delta	mixed	noise robust	Speed	Accuracy (no noise)
barrat	✅	✅	✅(maybe)	weak	fast	high
nac	✅	✅	✅(maybe)	weak	fast	high
maxent (chi2kink)	✅	❌	❌	strong	fast	high
ssk	❌	✅	❌	weak	slow	high
sac	✅	✅	❌(Difficult)	weak	slow	low
spx	✅(Against)	✅		weak	extremely slow	low
som	✅	✅	❌(difficult)	weak	little slow	low

Methods Compare(show ssk)

Why choose `ssk` in stochastic methods: It's the most accuracy method in stochastic methods.

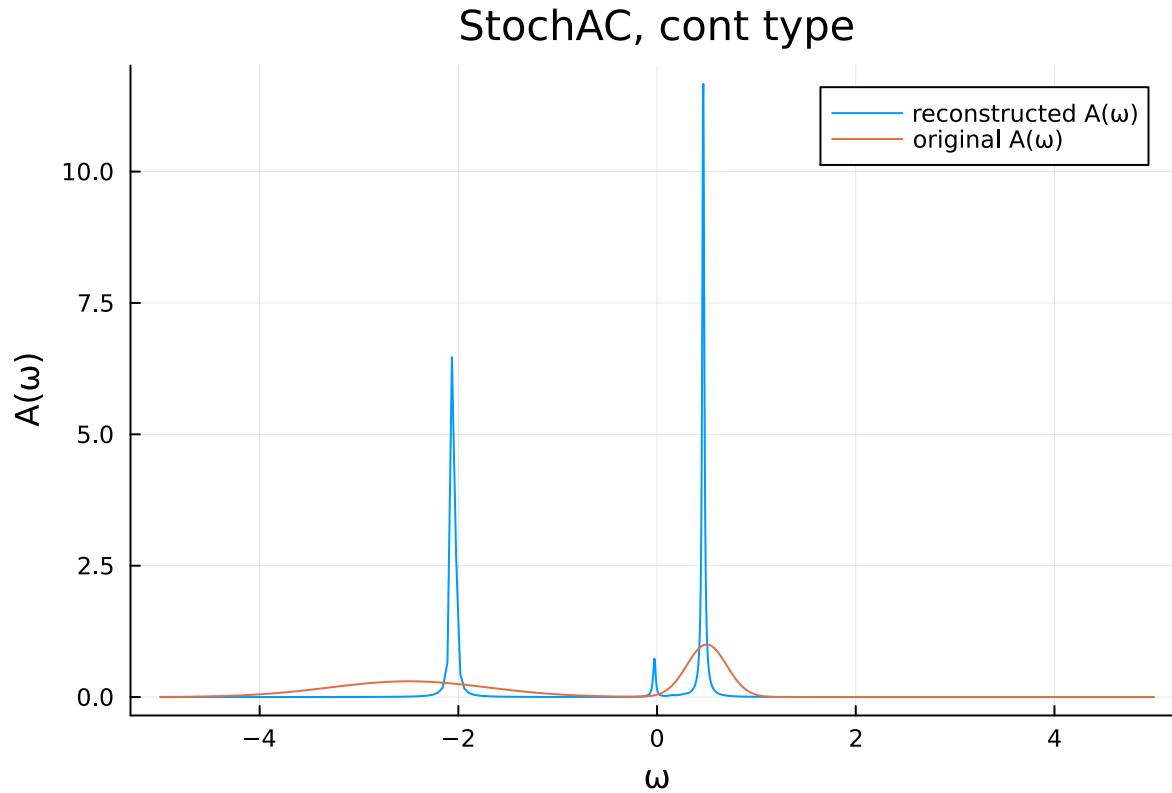# Methods Compare(show ssk)

SSK for smooth type
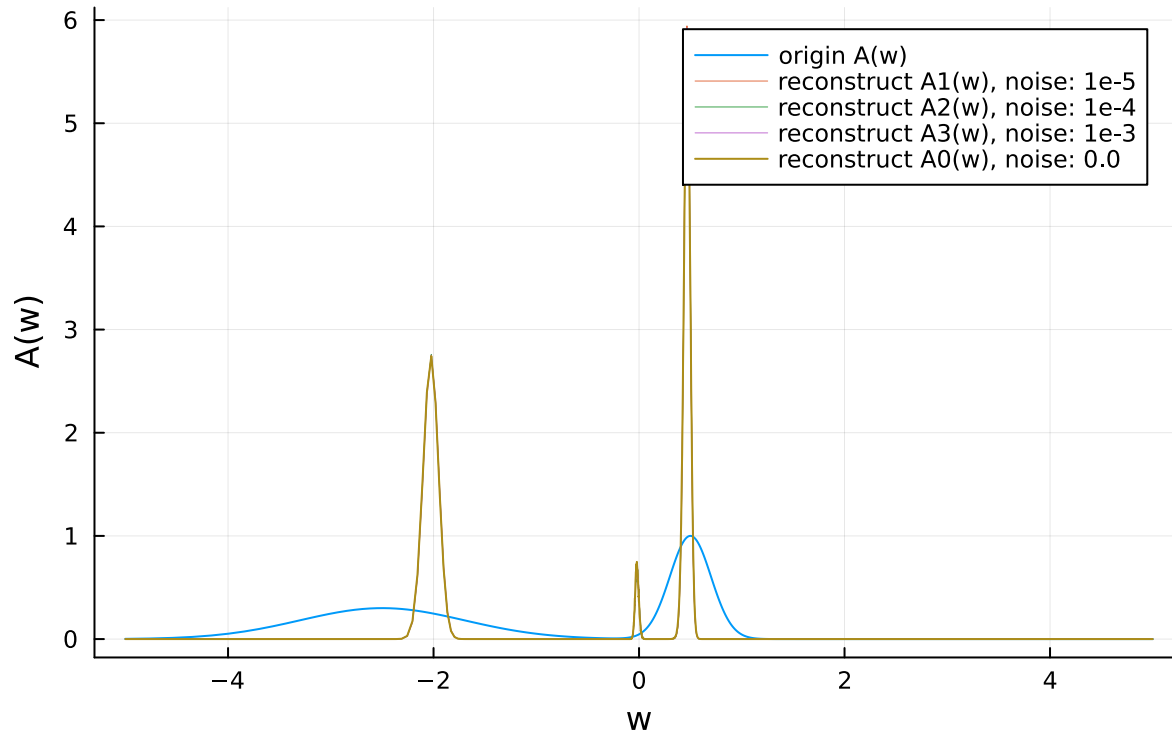
Methods Compare(show ssk)
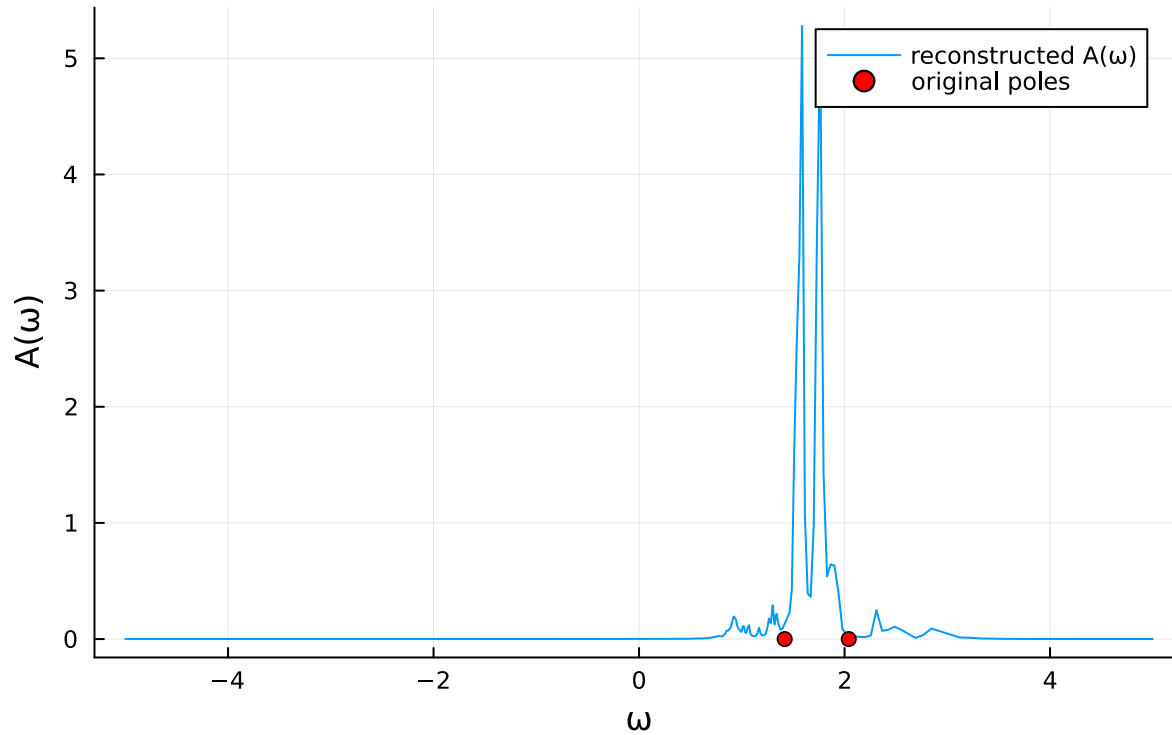

SSK for delta type

StochAC, cont type
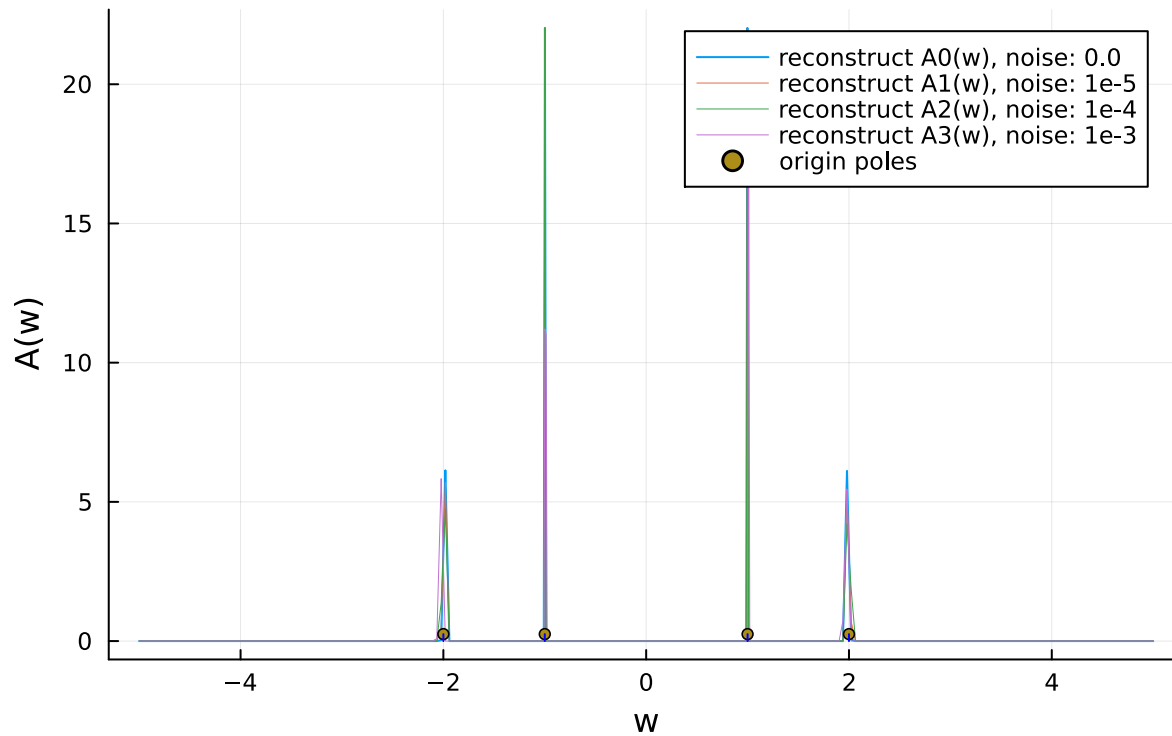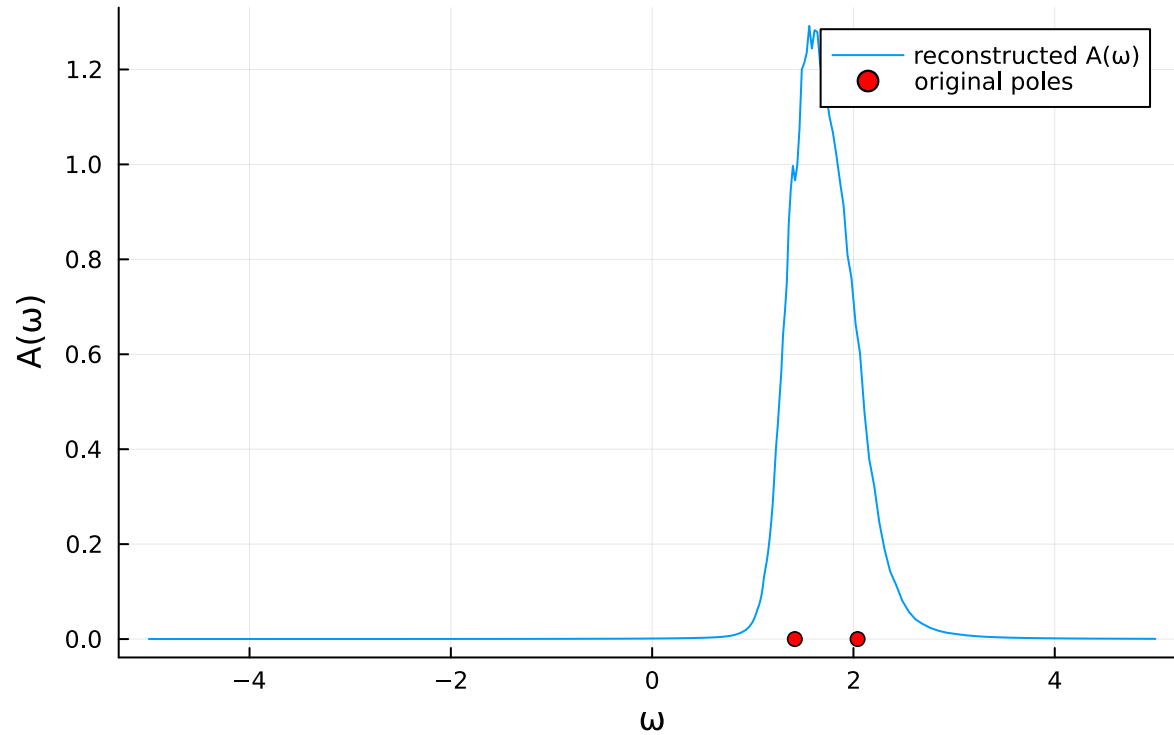
Methods Compare(sac vs ssk)

StochAC, delta type

StochAC, delta type

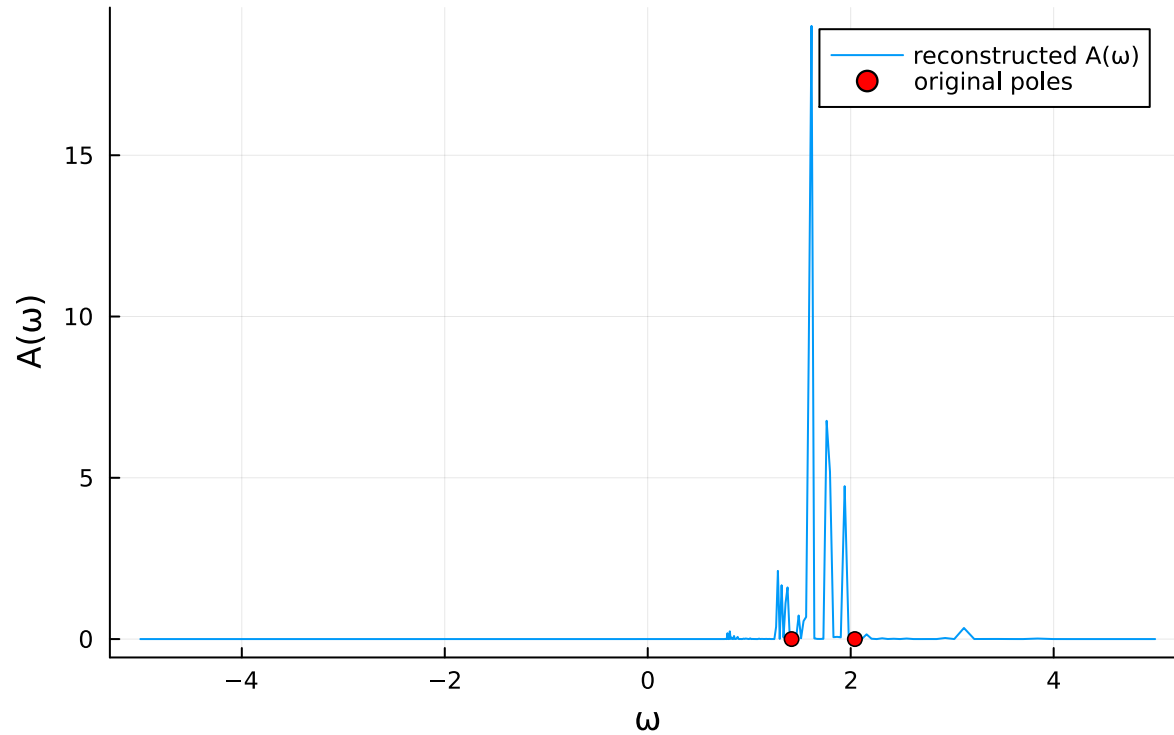# Methods Compare(som vs ssk)

StochOM, cont type

Methods Compare(som vs ssk)
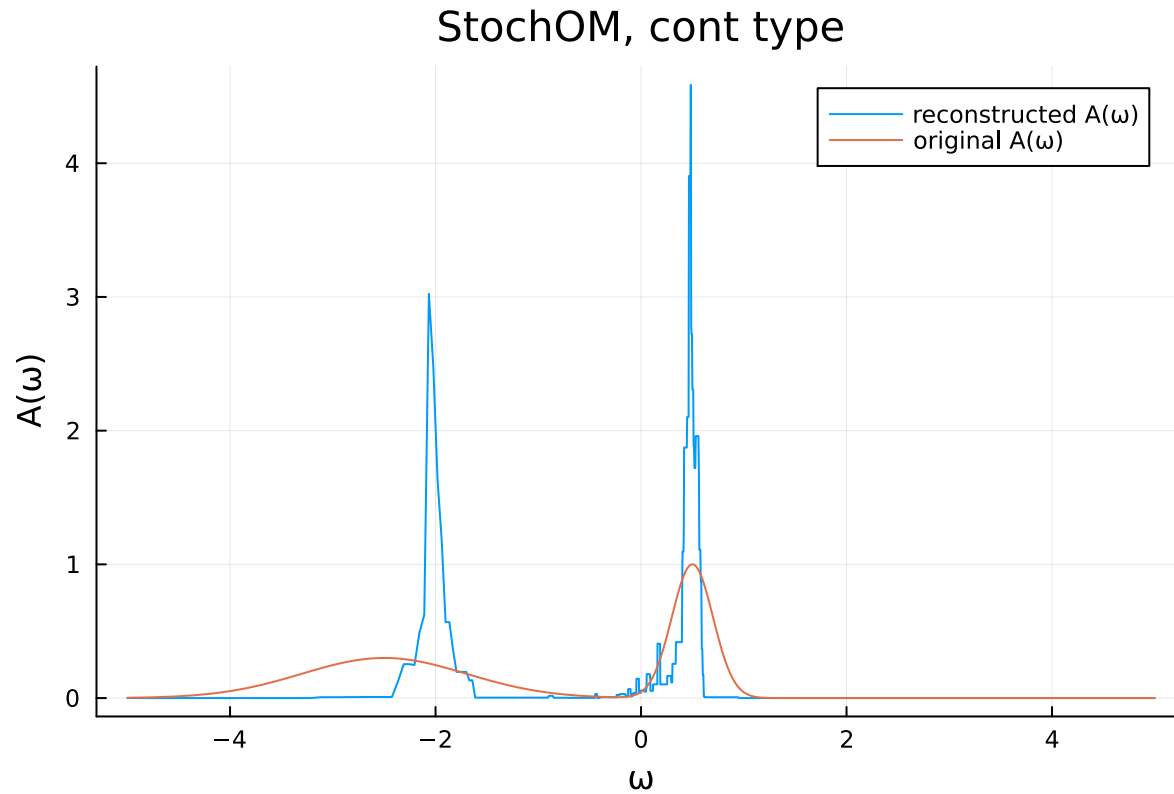
StochOM, delta type
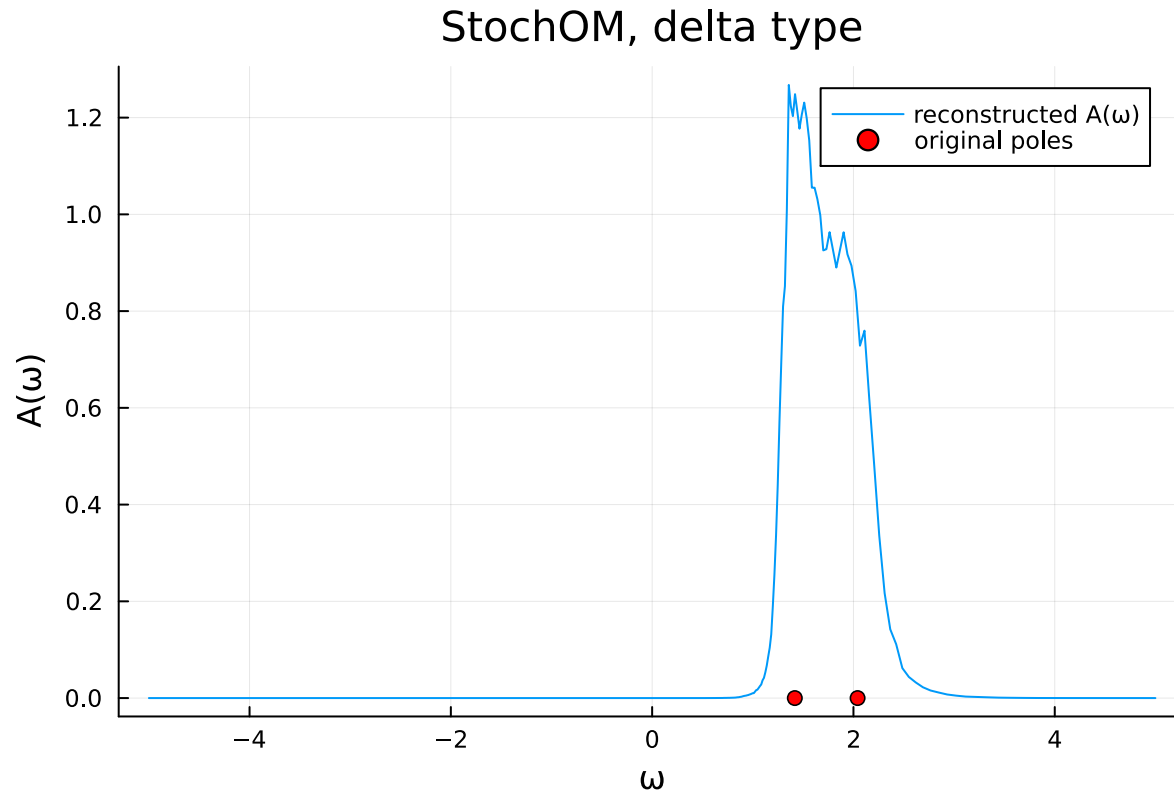
StochPX, delta type

Methods Compare(spx vs ssk)

Finally I choose `barrat`, `maxent(chi2kink)` and `ssk` to do sensitivity analysis.
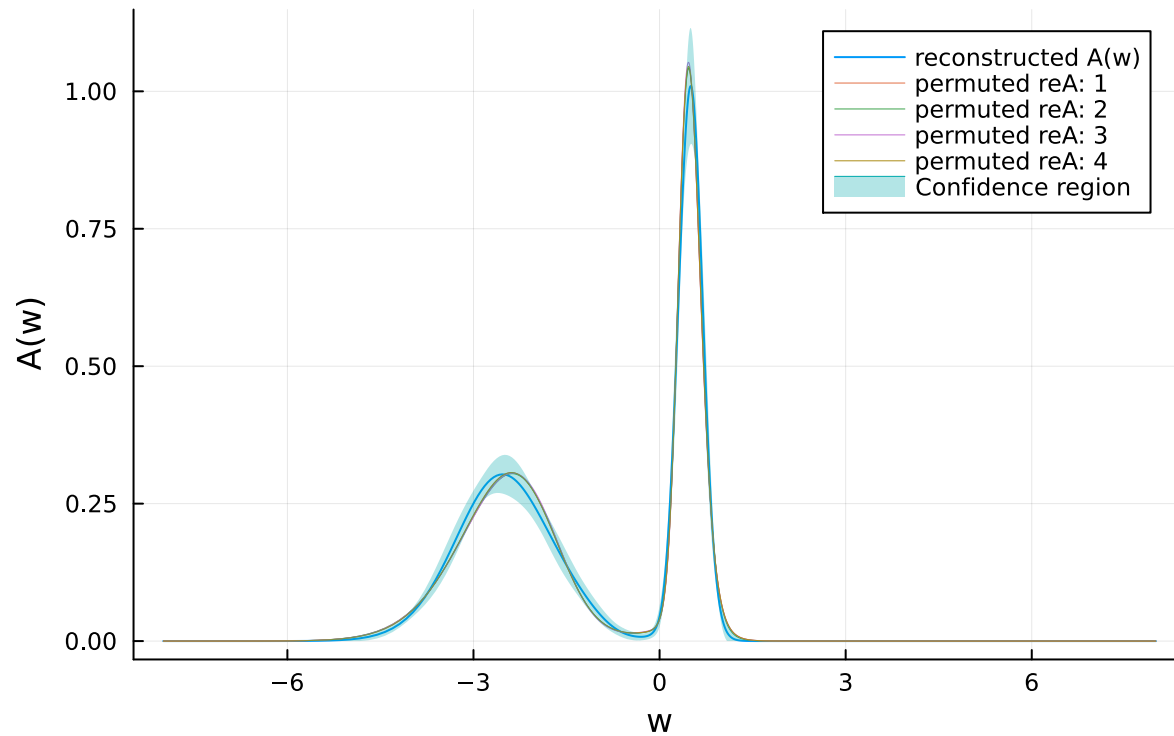
Analysis Results Show

(Show Tests)

Analysis Results Show

error bound, MaxEnt, Cont, perm: 0.0001

Analysis Results Show

Method	accuracy	stability
barrat	high	✅
maxent(chi2kink)	moderate	✅
ssk	low	❌