Hilbert transform, spectral filters and option pricing

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Online supplementary material

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Results with varying parameters for double barrier options

We provide these additional results to show that the performance of the pricing method is stable with respect to changing the values of the process parameters and the damping parameter.

Variation of the process parameters

We tested the method with the NIG and Kou processes using four different parameter sets shown in Table 1. We carried out all tests with 52 monitoring dates as the effect of varying the number of dates is covered in the results already included in the paper. The results are shown in Figures 1 and 2 and demonstrate that the error convergence changes very little between the different parameter sets.

Model	$\Psi(\xi, t)$	Symbol	Set 1	Set 2	Set 3	Set 4
NIG	$e^{-t\delta\left(\sqrt{\alpha^2-(\beta+i\xi)^2}+\sqrt{\alpha^2-\beta^2}\right)}$	α	15	20	18	15
		β	-5	-8	-12	-8
		δ	0.5	0.3	0.4	0.3
Kou	$e^{-t\left(\frac{\sigma^2\xi^2}{2}-\lambda\left(\frac{(1-p)\eta_2}{\eta_2+i\xi}+\frac{p\eta_1}{\eta_1-i\xi}-1\right)\right)}$	p	0.5	0.3	0.3	0.5
		λ	3	3	7	7
		σ	0.2	0.15	0.2	0.15
		η_1	50	25	50	50
		η_2	50	25	50	50

Table 1: Parameter sets for the underlying processes; $\Psi(\xi, t)$ is the characteristic function of the process that models the log return of the underlying asset.
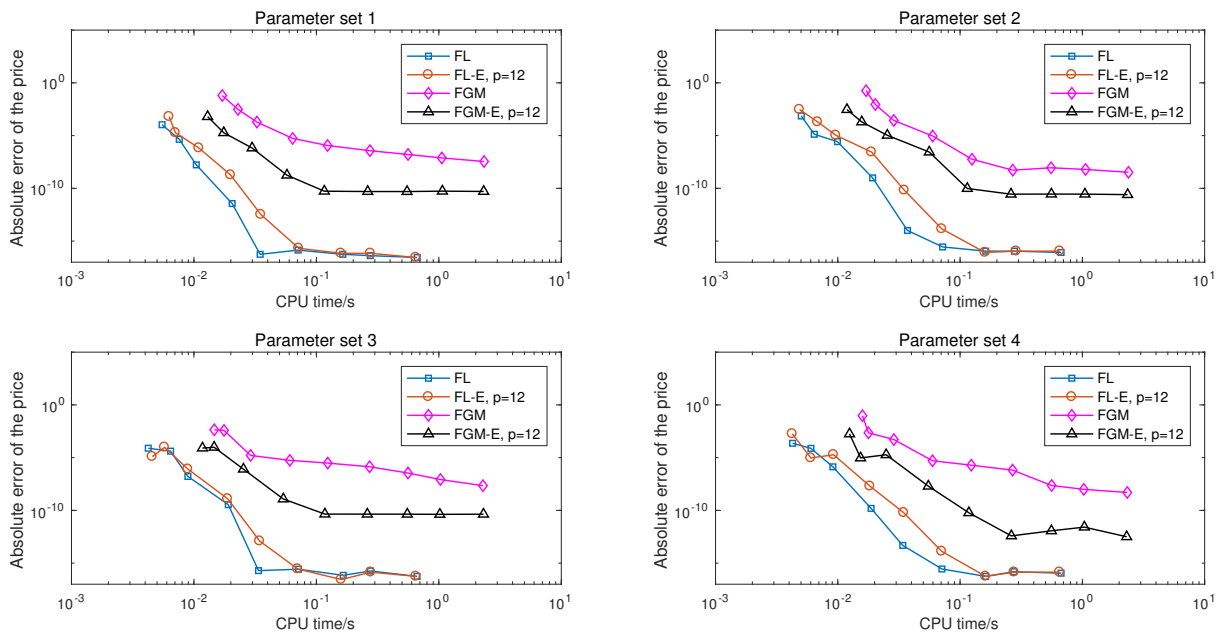
Figure 1: Results for the pricing error convergence with CPU time for the NIG process with the parameter sets described in Table 1.
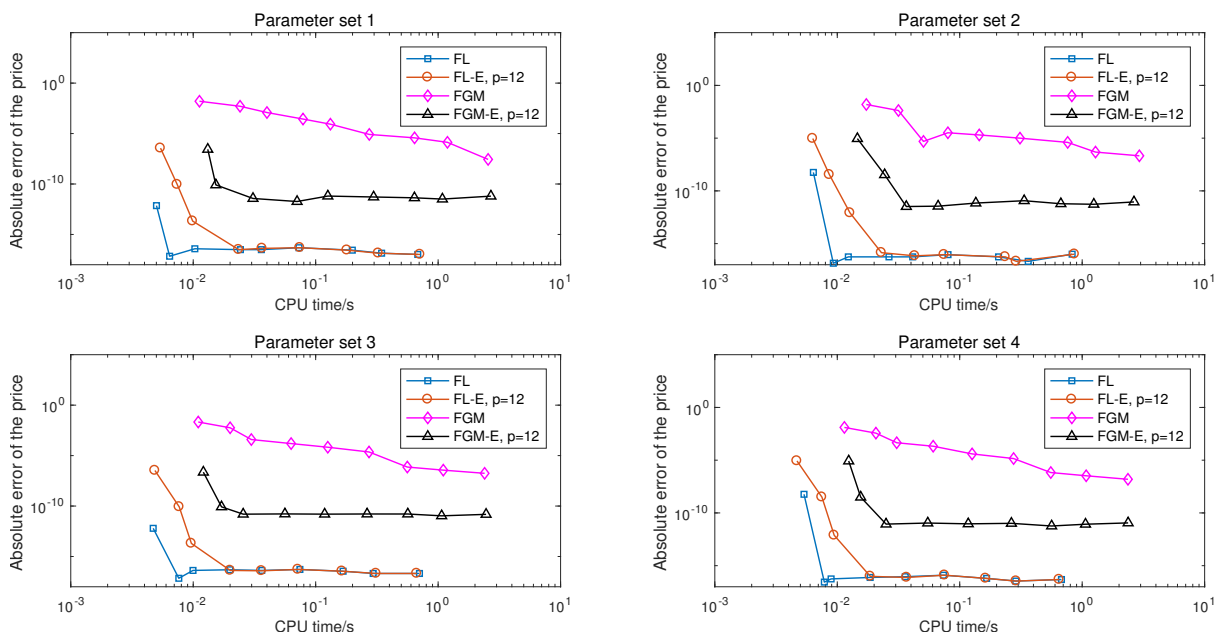

Figure 2: Results for the pricing error convergence with CPU time for the Kou process with the parameter sets described in Table 1.

Variation of the damping parameter

The method of selecting the damping parameter α in our pricing procedure originates in the paper by Feng and Linetsky (2008), referenced in our main paper. Feng and Linetsky suggest an acceptable range for α based on the process parameters. In the main paper, and in line with Fusai et al. (2016), we selected α at the centre of this range. For these additional tests we selected a number of values of α within a wide range. We can see from Figures 3 and 4 that the performance of the method is very robust against the variation of this parameter.
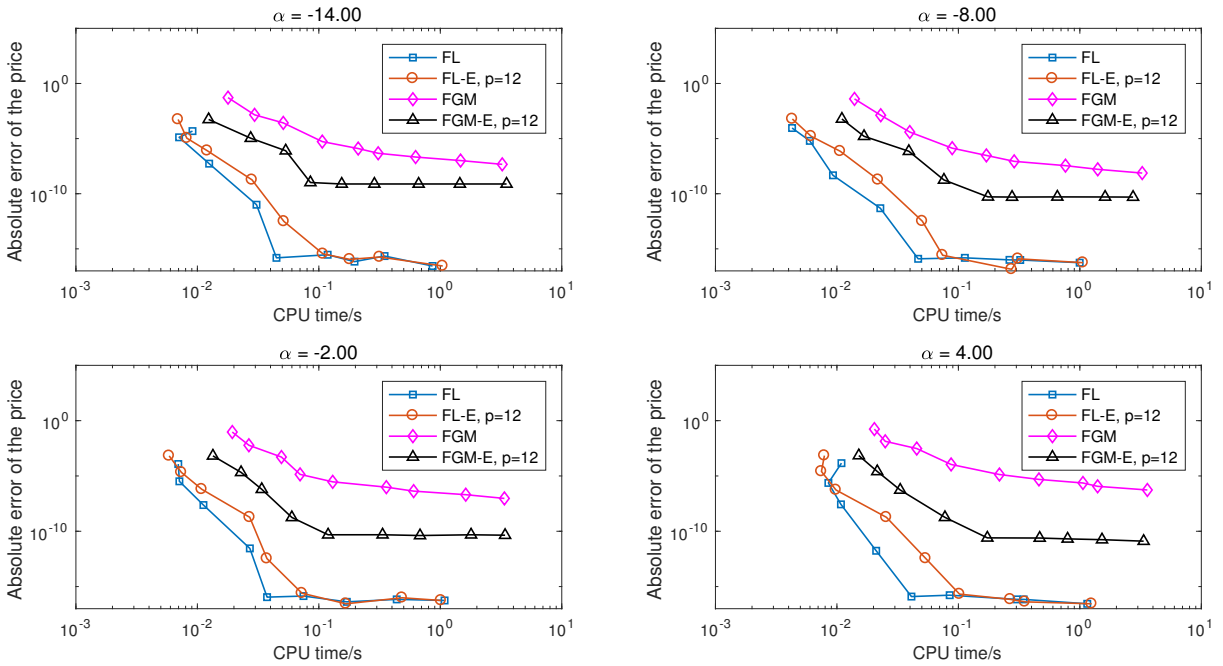

Figure 3: Results for the pricing error convergence with CPU time for the NIG process with different values of the damping parameter α.
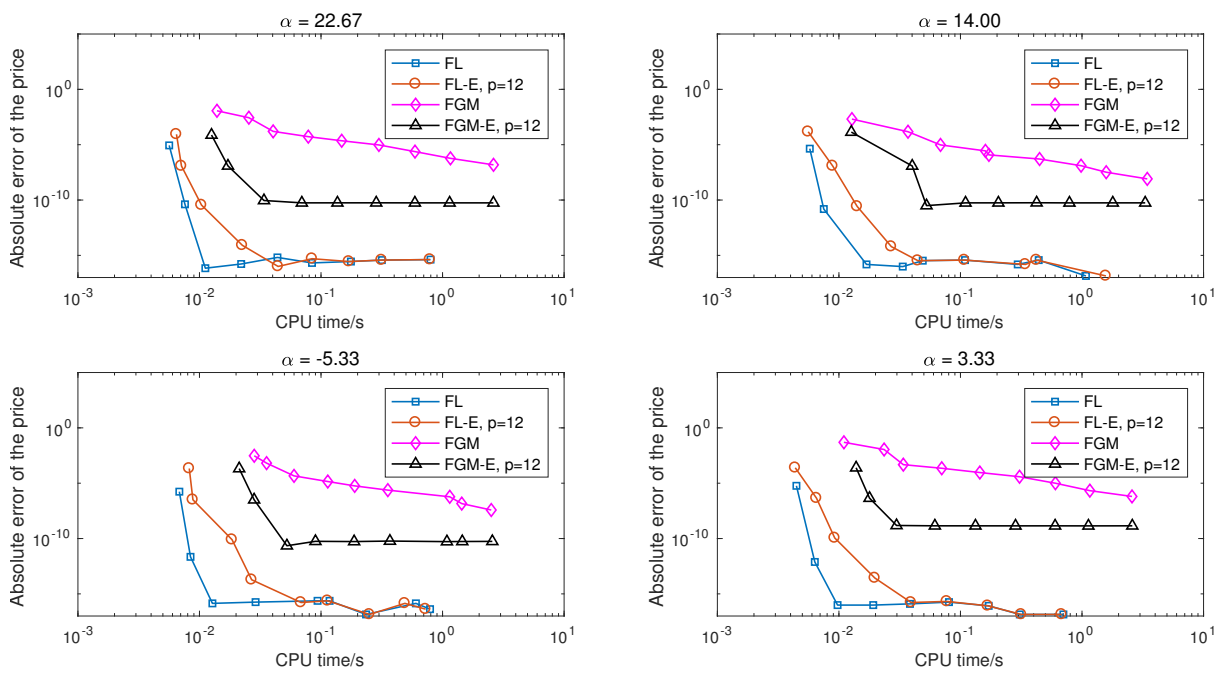
Figure 4: Results for the pricing error convergence with CPU time for the Kou process with varying values of the damping parameter α.