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INTEGRATING OSCILLATORY FUNCTIONS IN MATLAB, II*

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Abstract. In a previous study we developed a MATLAB program for the approximation of $\int_a^b f(x)\, e^{i\omega x}\, dx$ when ω is large. Here we study the more difficult task of approximating $\int_a^b f(x)\, e^{ig(x)}\, dx$ when $g(x)$ is large on $[a,b]$. We propose a fundamentally different approach to the task— backward error analysis. Other approaches require users to supply the location and nature of critical points of $g(x)$ and may require $g'(x)$. With this new approach, the program `quadgF` merely asks a user to define the problem, i.e., to supply $f(x)$, $g(x)$, $[a,b]$, and specify the desired accuracy. Though intended only for modest relative accuracy, `quadgF` is very easy to use and solves effectively a large class of problems. Of some independent interest is a vectorized MATLAB function for evaluating Fresnel sine and cosine integrals.

Key words. quadrature, oscillatory integrand, regular oscillation, irregular oscillation, backward error analysis, Filon, Fresnel integrals, MATLAB

AMS subject classifications. 65D30, 65D32, 65D07

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