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A FAMILY OF GENERALIZED GAUSS-NEWTON'S METHODS FOR 2D INVERSE GRAVIMETRY PROBLEM

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We consider a generalized Gauss-Newton's scheme

$$x_{n+1} = \xi - \theta(F'^*(x_n)F'(x_n), \alpha_n)F'^*(x_n)\{F(x_n) - f - F'(x_n)(x_n - \xi)\}$$

for solving nonlinear unstable operator equation $F(x) = f$ in a Hilbert space. In case of noisy data we propose a novel a posteriori stopping rule

$$||F(x_N) - f_\delta||^2 \leq \tau\delta < ||F(x_n) - f_\delta||^2, 0 \leq n < N, \tau > 1,$$

and prove a convergence theorem under a source type condition on the solution. As a consequence of this theorem we obtain convergence rates for five different generating functions, $\theta = \theta(\lambda, \alpha)$, of a spectral parameter λ and $\alpha > 0$.

The new algorithms are tested on the 2D inverse gravimetry problem reduced to a nonlinear integral equation of the first kind:

$$F(x) := g \triangle\sigma \int_a^b \int_c^d \left\{ \frac{1}{[\,(\xi - t)^2 + (\nu - s)^2 + x^2(\xi, \nu)\,]^{1/2}} \right.$$
$$\left. - \frac{1}{[\,(\xi - t)^2 + (\nu - s)^2 + h^2\,]^{1/2}} \right\} d\xi\, d\nu = f(t, s),$$

where g is the gravitational constant, $\triangle\sigma$ is the density jump on the interface, and $f(t, s)$ is the gravitational strength anomaly. The results of numerical simulations are presented and some practical recommendations on the choice of parameters are given.