

Manual of NEQ_ReSNA

— ReSNA Plugin for Nonlinear Equations —

Shunsuke Hayashi*

September 4, 2013

1 Problem

`NEQ_ReSNA.m` solves (tries to solve) the Nonlinear Equation (NEQ) expressed as follows:

$$\begin{aligned} &\text{Find } p \in \mathbb{R}^l \\ &\text{such that } F(p) = 0, \end{aligned} \tag{1.1}$$

where $F : \mathbb{R}^l \rightarrow \mathbb{R}^l$ is a given continuously differentiable function.

2 How to use the plugin

Putting `ReSNA.m` in the same folder, you can use `NEQ_ReSNA.m` as follows.

Usage 1: `[p] = NEQ_ReSNA(FUNC,nabFUNC,e1)`

Usage 2: `[p] = NEQ_ReSNA(FUNC,nabFUNC,e1,p0)`

- **FUNC** — implies the function $F : \mathbb{R}^n \rightarrow \mathbb{R}^n$ in problem (1.1). If function m-file `F.m` plays a role of function F , then put `F.m` in the same folder and let `FUNC=@F`. (“at mark” is required before the name of function m-file.)
- **nabFUNC** — implies $\nabla F : \mathbb{R}^l \rightarrow \mathbb{R}^{l \times l}$, i.e., the transposed Jacobian of function F . If function m-file `nabF.m` plays a role of function ∇F , then put `nabF.m` in the same folder and let `nabFUNC=@nabF`. If you do not have the closed form of $\nabla F(p)$, let `nabFUNC=[]`. In this case, $\nabla F(p)$ is approximated by means of the finite difference method.
- **e1** — implies the value of l , i.e., the dimension of p or $F(p)$ in problem (1.1). `e1` should be given as a positive integer.
- **p0** — implies the initial point $p^{(0)}$ for the regularized smoothing Newton algorithm (Algorithm 4.1 in `manual_ReSNA.pdf`). `p0` should be given as a column vector whose length is equal to `e1`. If you omit `p0` or let `p0=[]`, then ReSNA chooses a random vector from $[-1, 1]^l$ automatically.

Parameters in `ReSNA.m`

- **PROGRESS** — decides whether or not ReSNA displays the detailed progress of the iteration. The default value is `'Y'`.

*Graduate School of Information Sciences (GSIS), Tohoku University (s_hayashi@plan.civil.tohoku.ac.jp)

- `tole` — is used for the termination criterion in Step 1 (Algorithm 4.1 in `manual_ReSNA.pdf`). When $\|H_{\text{NR}}(w^{(k)})\| \leq \text{tole}$, the algorithm terminates normally and the obtained output is guaranteed to be the solution of problem (1.1). The default value is `1e-8`.
- `tole_diff` — is used for approximating the Jacobian matrix by means of the finite difference method. The default value is `1e-8`.
- `eta`, `eta_bar`, `rho`, `sigma`, `kappa`, `kappa_bar`, `kappa_hat` — are the parameters indicated in Algorithm 4.1 in `manual_ReSNA.pdf`. Some default values are assigned automatically.