

# leigqNEWTON\_cert\_resMin — eigenvalue-only residual certificate

Compute  $\text{resMin}(A, \lambda) = \min_{\|x\|=1} \|A \cdot x - \lambda \cdot x\|$  and (optionally) the minimizer vector.

## Setup (requirements + path)

```
hasQuat = true;
try
    quaternion(0,0,0,0);
catch
    hasQuat = false;
end
if ~hasQuat
    disp('This toolbox requires MATLAB''s built-in quaternion class
(quaternion(w,x,y,z)).');
    disp('Examples in this page are skipped.');
```

```
    return;
end

if exist('leigqNEWTON_cert_resMin','file') ~= 2
    thisFile = mfilename('fullpath');
    if ~isempty(thisFile)
        rootGuess = fileparts(fileparts(fileparts(thisFile))); % ../docs/source ->
toolbox root
        if exist(fullfile(rootGuess, 'leigqNEWTON_cert_resMin.m'), 'file')
            addpath(rootGuess);
        end
    end
end

if exist('leigqNEWTON_cert_resMin','file') ~= 2
    error('leigqNEWTON_cert_resMin not found on the MATLAB path. Add the toolbox
root folder.');
```

```
end
```

## Syntax

- $r = \text{leigqNEWTON\_cert\_resMin}(A, \lambda)$
- $[r, x] = \text{leigqNEWTON\_cert\_resMin}(A, \lambda)$
- $\dots = \text{leigqNEWTON\_cert\_resMin}(\dots, 'ResidualNormalized', \text{true/false})$

## Example 1: Huang–So Example 2.5 (2×2, known eigenvalues)

```
q0 = quaternion(0,0,0,0);
q1 = quaternion(1,0,0,0);
qi = quaternion(0,1,0,0);

A = [ q0, q1 + qi;
      q1 - qi, q0 ];
```

```

lamTrue = [ quaternion(sqrt(2),0,0,0);
            quaternion(-sqrt(2),0,0,0) ];

[r,x] = leigqNEWTON_cert_resMin(A, lamTrue, 'ResidualNormalized',false);
disp(r);

1.0e-15 *
    0.1276
    0.0707

```

## Example 2: compute best vectors for a candidate set (Pan–Ng 4×4)

```

q = @(w,x,y,z) quaternion(w,x,y,z);
a = q(-2, 1, 1, 4);
b = q( 2, 4, 1, 1);
c = q( 1, 3, 2, 2);
d = q(-1, 2, 2, 3);
A = [a b c d;
      d a b c;
      c d a b;
      b c d a];

lambda = leigqNEWTON(A,'SolveProfile','reliable','Seed',1);
[resMinAbs, X] = leigqNEWTON_cert_resMin(A, lambda, 'ResidualNormalized',false);
size(X)

```

```

ans = 1×2
     4     4

```

```

median(resMinAbs), max(resMinAbs)

```

```

ans =
9.6237e-16
ans =
3.7669e-12

```

## See also

leigqNEWTON\_cert\_resPair, leigqNEWTON\_refine\_batch, checkNEWTON