(a)

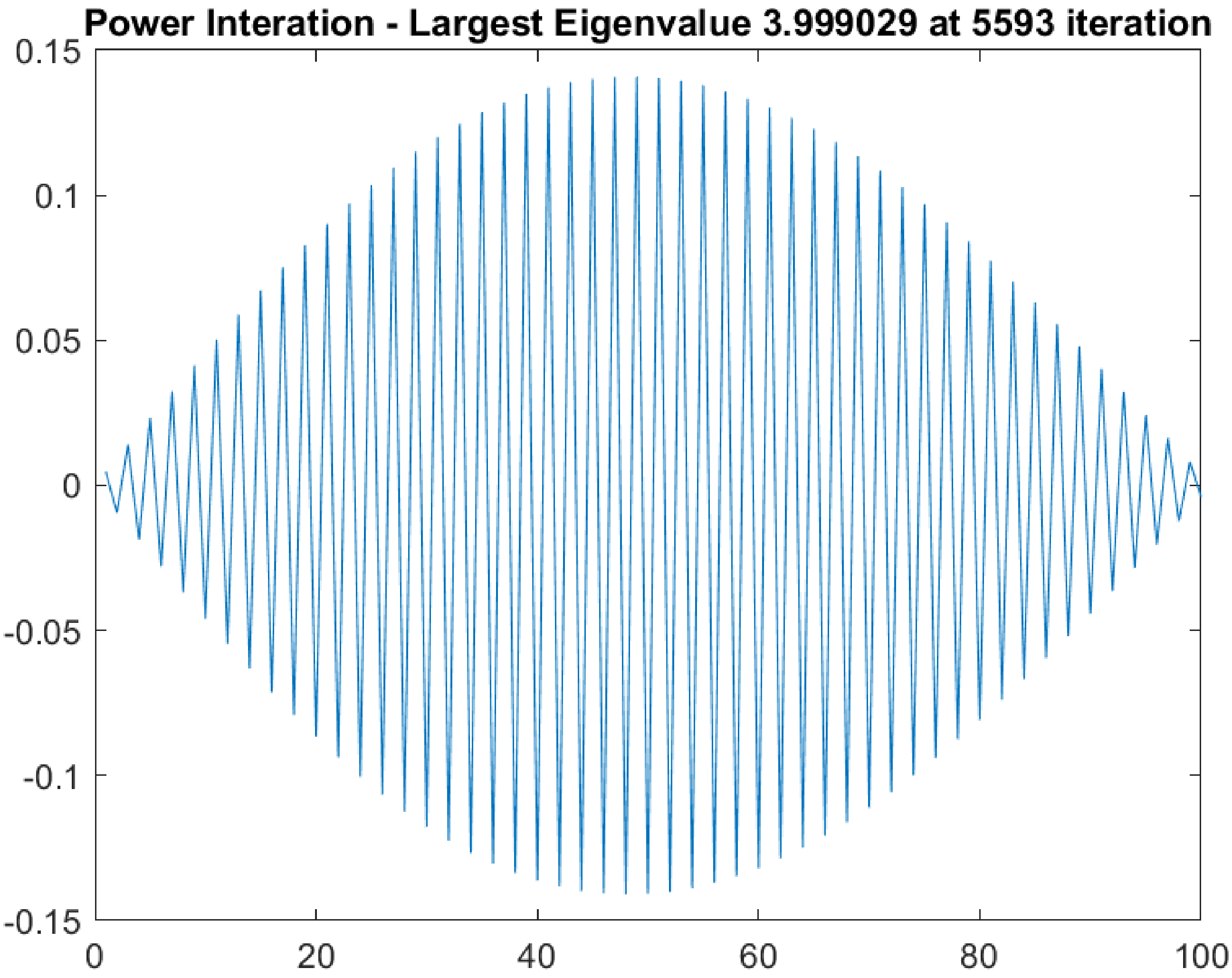
```
function [v,lambda,iter] =  PowerIteration(A,v0,maxiter,tol)
    v = v0;
    for k = 1:maxiter
        iter = k;
        w = A*v;
        v = w/norm(w);
        lambda = v' * A * v;
        if norm(A * v - lambda * v) < tol
            break
        end
    end
end
```

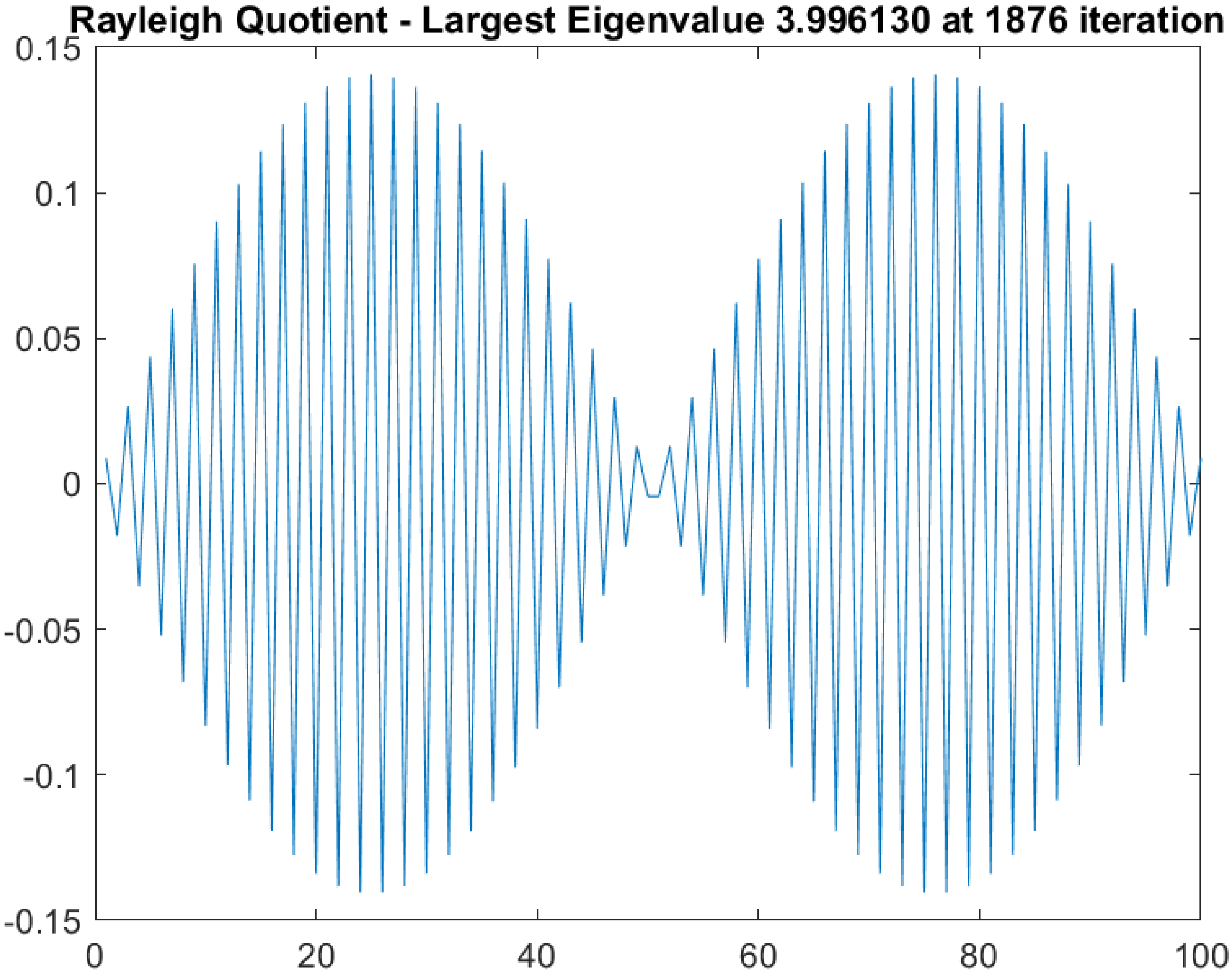
```
function [v,lambda,iter] = RayleighQuotient(A,v0,maxiter,tol)
    n = size(A, 1);
    v = v0;
    lambda = v' * A * v;
    for k = 1:maxiter
        iter = k;
        w = (A - lambda * eye(n)) \ v;
        v = w/norm(w);
        lambda = v' * A * v;
        if norm(A * v - lambda * v) < tol
            break
        end
    end
end
```

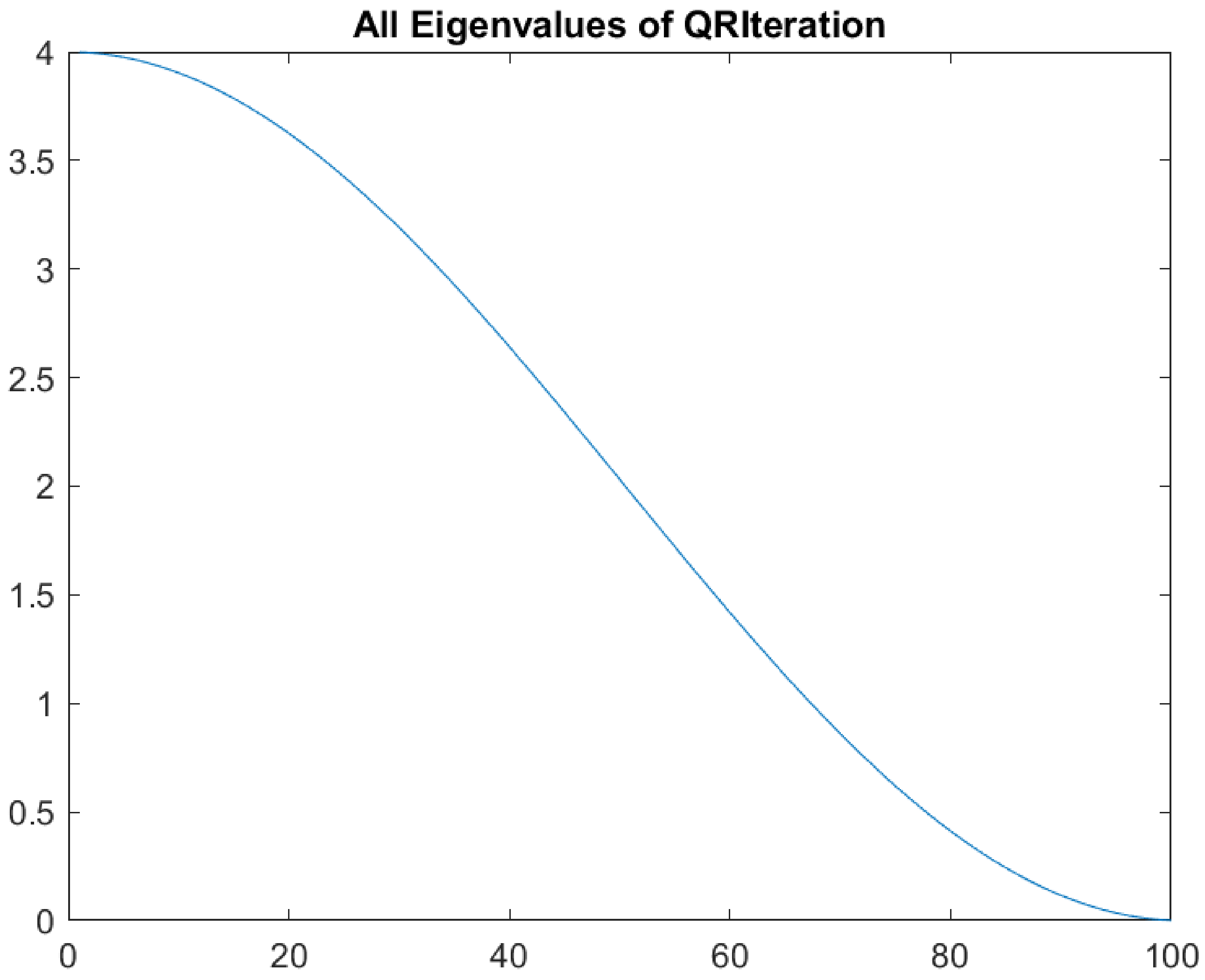
```
function [V,Lambda,iter] = QRIteration(A,maxiter,tol)
    intermediate = A;
    n = size(A,1);
    V = eye(n);
    for iter = 1:maxiter
        [Q,R] = qr(intermediate);
        V = V * Q;
        intermediate = R * Q;
        Lambda = diag(intermediate);
        if (all(norm(A .* V - Lambda .* V)) < tol)
            break
        end
    end
end
```

(b)

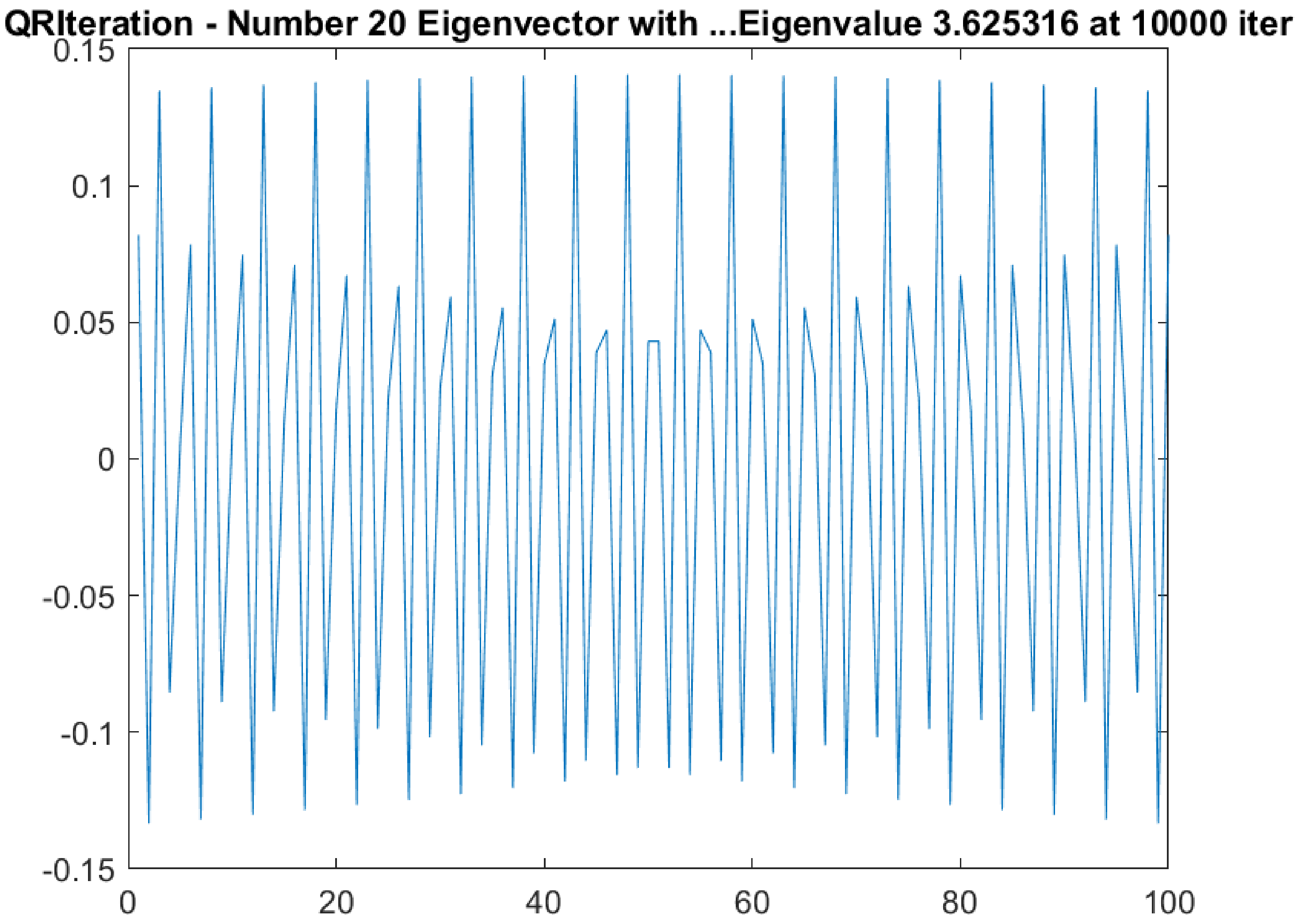
```
function EigenMethods()
    n = 100;
    A = diag(2*ones(1,n))+diag(-1*ones(1,n-1),1)+diag(-1*ones(1,n-1),-1);
    maxiter = 10000;
    tol = 1e-4;
    vp0 = zeros(n,1);
    vp0(1) = 1;
    vr0 = ones(n,1);

    [vp,lambdap,iterp] =  PowerIteration(A,vp0,maxiter,tol);
    plot(vp);
    title(...
        sprintf("Power Interation - Largest Eigenvalue %f at %d iteration",...
        lambdap, iterp));
    saveas(gcf,'PowerIteration.png');

    [vr,lambdar,iterr] =  PowerIteration(A,vr0,maxiter,tol);
    plot(vr);
    title(...
        sprintf("Rayleigh Quotient - Largest Eigenvalue %f at %d iteration",...
        lambdar, iterr));
    saveas(gcf,'RayleighQuotient.png');

    [V,Lambda,iter] = QRIteration(A,maxiter,tol);
    plot(Lambda);
    title("All Eigenvalues of QRIteration");
    saveas(gcf,'AllEigenvalues.png');

    for i = 1:4
        pos = 20 * i;
        plot(V(:,pos));
        title(...
        sprintf("QRIteration - Number %d Eigenvector with ..." + ...
        "Eigenvalue %f at %d iteration", pos, Lambda(pos), iter));
        saveas(gcf,sprintf("QRIteration%d.png",pos));
    end

end
```

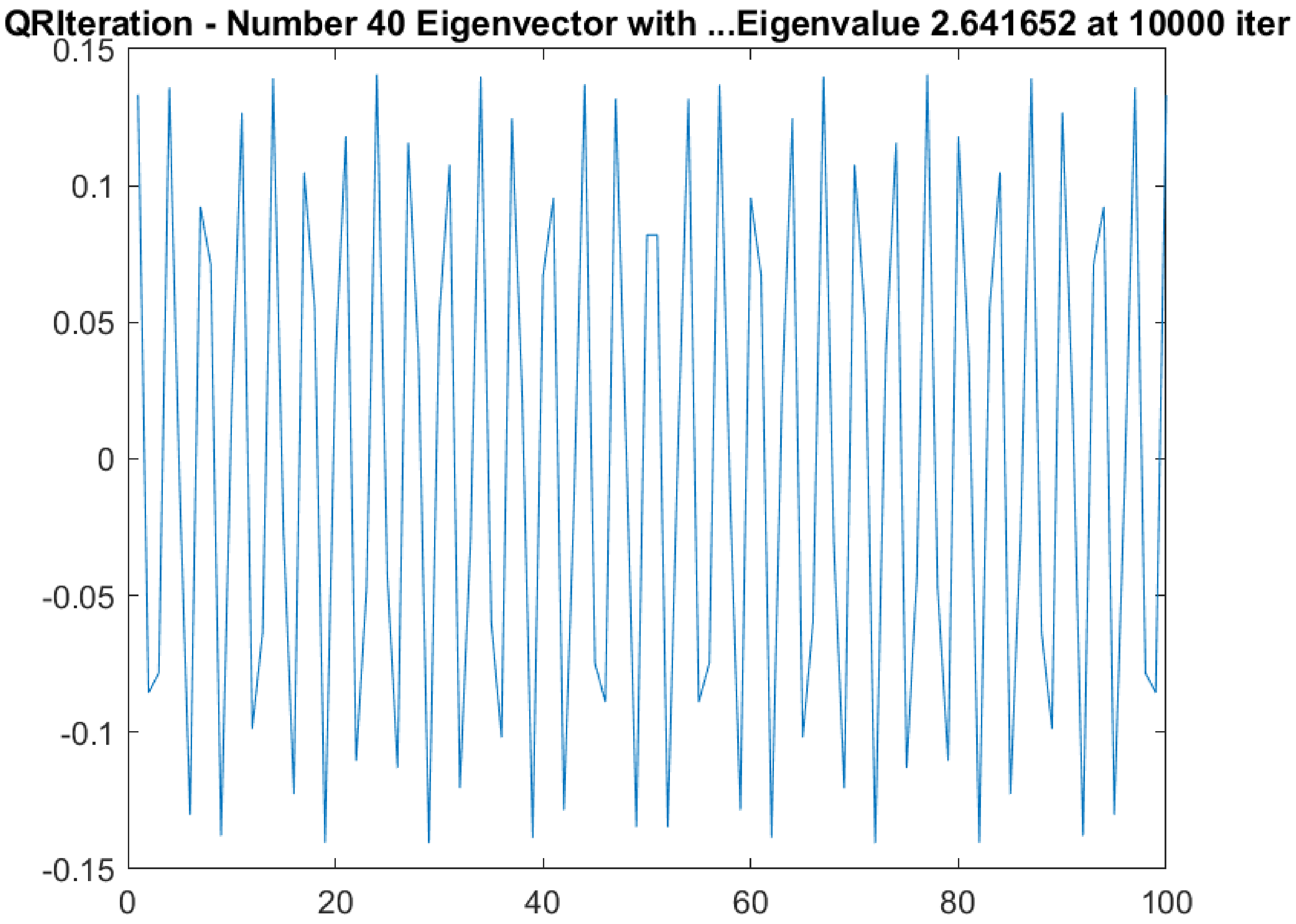

Power Interation - Largest Eigenvalue 3.999029 at 5593 iteration
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
0
20
40
60
80
100

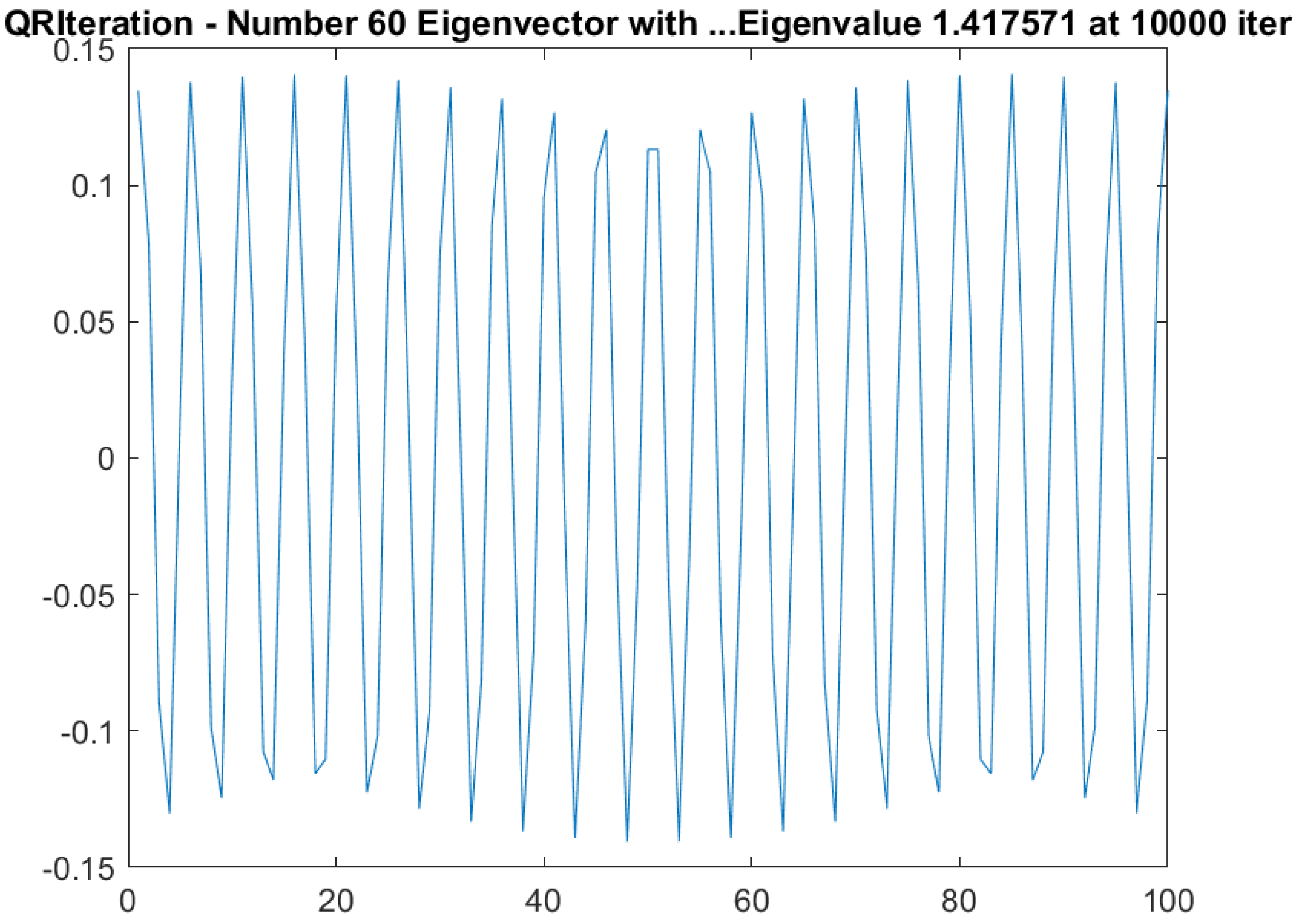

Rayleigh Quotient - Largest Eigenvalue 3.996130 at 1876 iteration
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
0
20
40
60
80
100

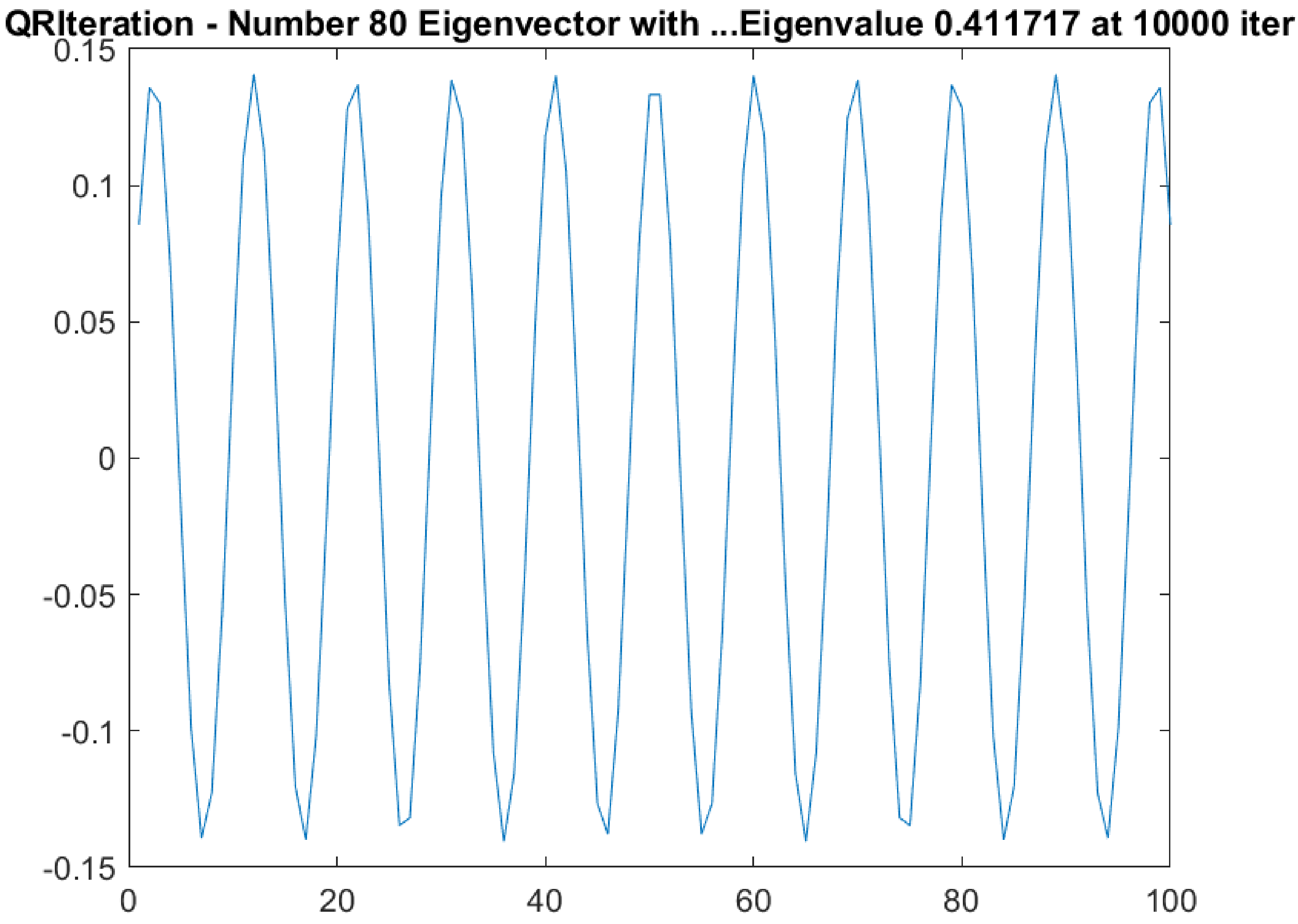


All Eigenvalues of QRIteration


QRIteration - Number 20 Eigenvector with ...Eigenvalue 3.625316 at 10000 iter
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
0
20
40
60
80
100


QRIteration - Number 40 Eigenvector with ...Eigenvalue 2.641652 at 10000 iter
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
0
20
40
60
80
100


QRIteration - Number 60 Eigenvector with ...Eigenvalue 1.417571 at 10000 iter
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
0
20
40
60
80
100


QRIteration - Number 80 Eigenvector with ...Eigenvalue 0.411717 at 10000 iter
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
0
20
40
60
80
100