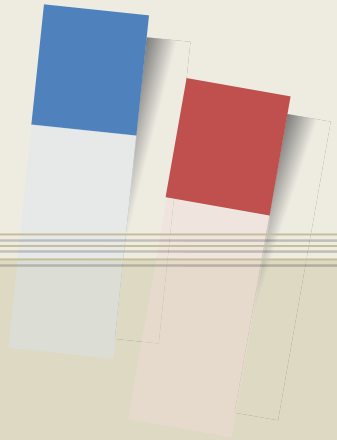
Dr. Sang-Chul Kim



Open Method: Coding for Newton-Raphson

Matlab code for newtraph

```
function [root, ea, iter]=newtraph(func,
dfunc, xr, es, maxit, varargin)

if nargin < 3
   error('at least 3 input argyments
required')
end

if nargin < 4 | isempty(es)
   es=0.0001;
end

if nargin < 5 | isempty(maxit)
   maxit=50;
end

iter=0;

while(1)
   xrold=xr;
   xr=xr-func(xr)/dfunc(xr);
   iter=iter+1;

   if xr ~= 0
      ea=abs((xr-xrold)/xr)*100;
   end

   if ea <= es | iter >= maxit
      break
   end

   root=xr;
end
```

실행

$$f'(m) = \frac{1}{2} \cdot \sqrt{\frac{g}{mc_d}} \cdot tanh\left(\sqrt{\frac{gc_d}{m}} \cdot t\right) - \frac{gt}{2m} \cdot sech^2\left(\sqrt{\frac{gc_d}{m}} \cdot t\right)$$

$$f(m) = \sqrt{\frac{gm}{c_d}} \cdot tanh\left(\sqrt{\frac{gc_d}{m}} \cdot t\right) - 36$$

>> y=@(m) sqrt(9.81*m/0.25)*tanh(sqrt(9.81*0.25/m)*4)-36

>> dy=@(m) 1/2*sqrt(9.81/(m*0.25))*tanh(sqrt(9.81*0.25/m)*4)-9.81*4/(2*m)***(sech(sqrt(9.81*0.25/m)*4))^2**

>> [root, ea, iter]=**newtraph**(y, dy, **140**, 0.00001)

root = 142.7376, ea = 9.9078e-006, **iter = 3**

>> [root, ea, iter]=**newtraph**, dy, **200**, 0.00001)

root = 142.7376, ea = 9.4669e-006, **iter = 5**

>> [root, ea, iter]=**newtraph**, dy, **40**, 0.00001)

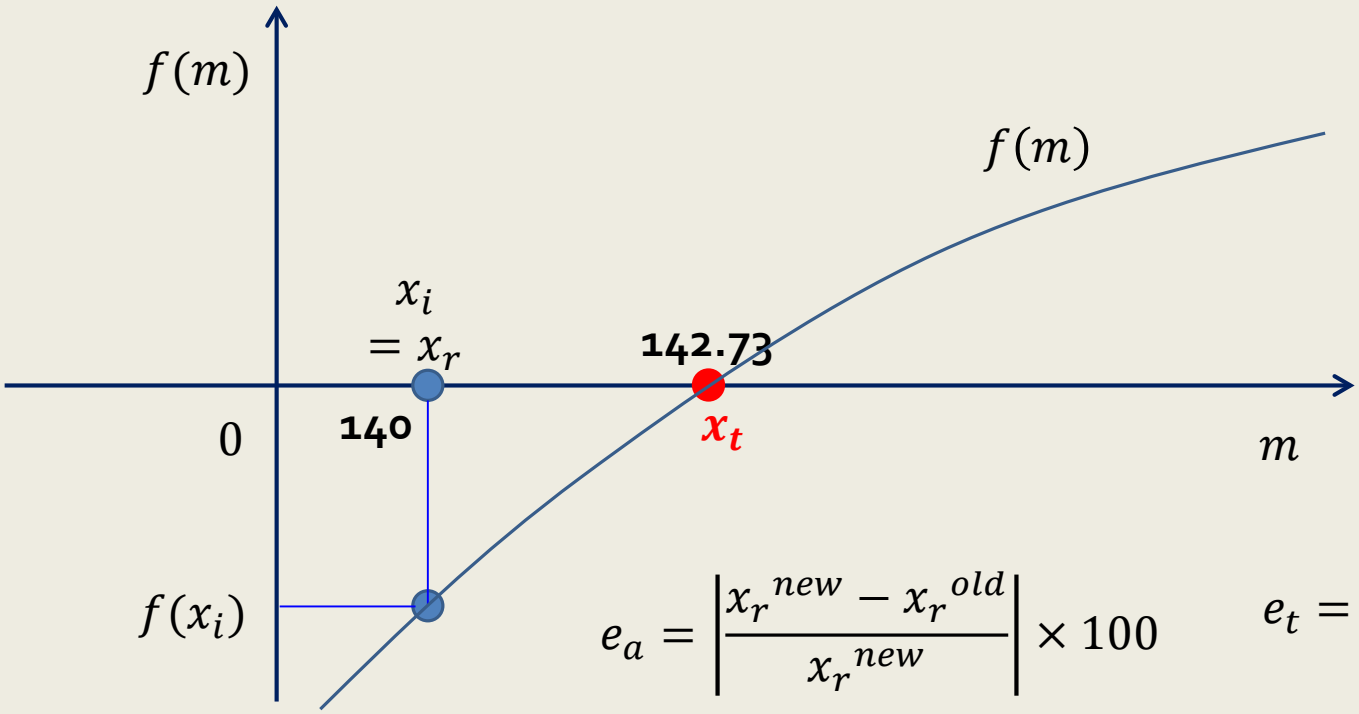
root = 142.7376, ea = 1.0732e-010, **iter = 7**

>> [rootb, fxb, eab, iterb]=**bisect**(y, 40, 200
0.00001, 50)
rootb = 142.7376, fxb = -1.2435e-007
eab = 6.6813e-006, **iterb = 24**

분석

```
>> func=y
func =
    @(m)sqrt(9.81*m/0.25)*tanh(sqrt(9.81*0.25/m)*4)-36

>> dfunc=dy
dfunc =
    @(m)1/2*sqrt(9.81/(m*0.25))*tanh(sqrt(9.81*0.25/m)*4)-
9.81*4/(2*m)*(sech(sqrt(9.81*0.25/m)*4))^2

>> xr=140
xr =
   140

>> es=0.00001
es =
  1.0000e-005

>> iter=0
iter =
     0
```

Error 그래프 그리기 위한 기초(iter=0)

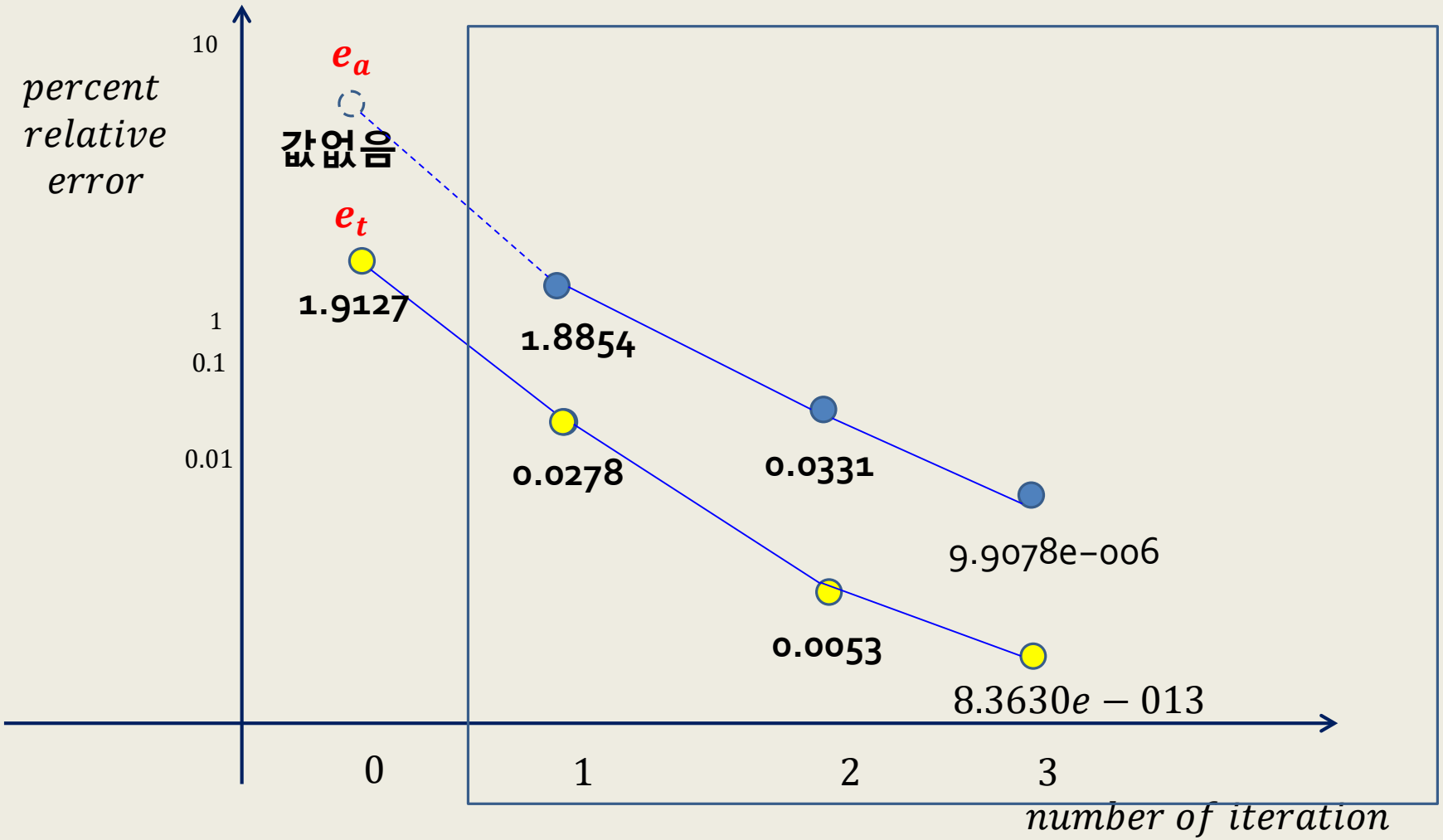


$$e_a = \left|\frac{{x_r}^{new} - {x_r}^{old}}{{x_r}^{new}}\right| \times 100$$

$$e_t = \left|\frac{x_t - x_r}{x_t}\right| \times 100$$

xr_old	*xr_new*	*ea*	*et*
값 없음	140	$\left\|\frac{140-\text{없음}}{140}\right\| \times 100$=값없음	$\left\|\frac{142.73-140}{142.73}\right\| \times 100$=19.13%

e_a and e_t

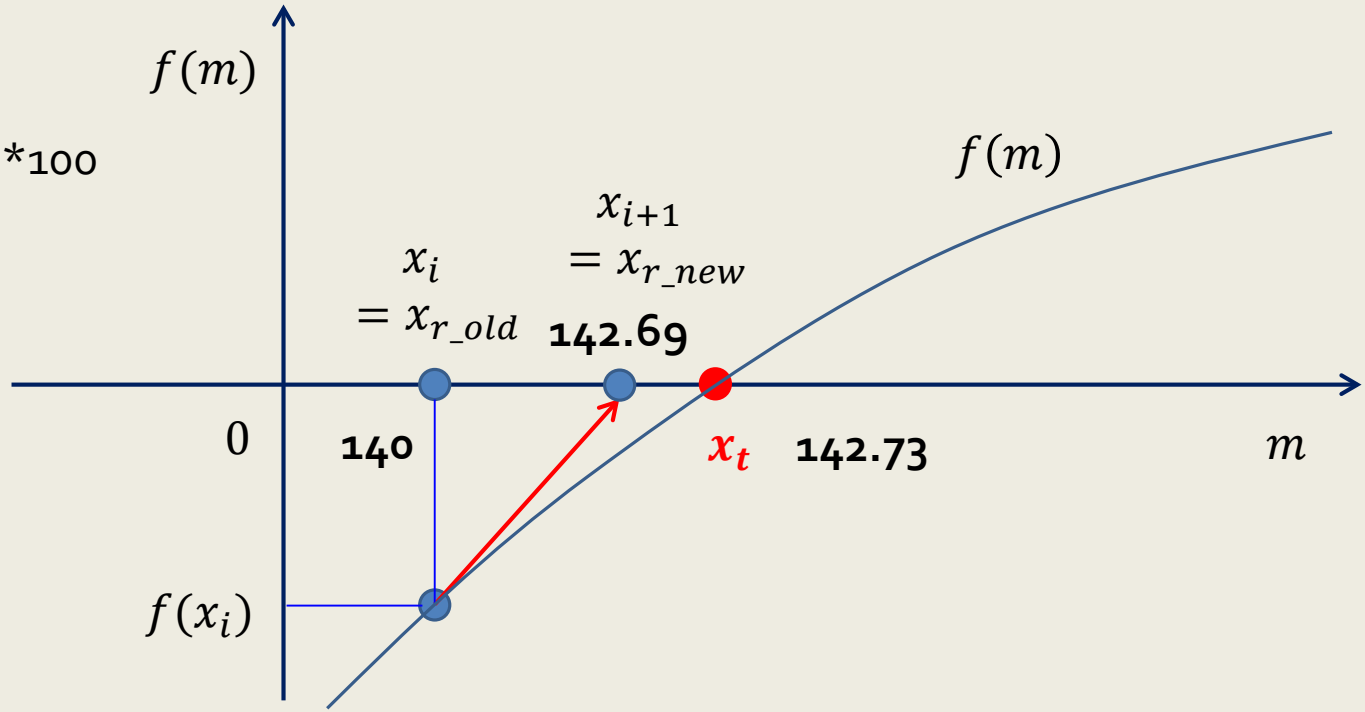

10
1
0.1
0.01
percent relative error
e_a
값없음
e_t
1.9127
1.8854
0.0278
0.0331
9.9078e-006
0.0053
$8.3630e-013$
0
1
2
3
number of iteration

분석 (iter=1)

```
>> xrold=xr
xrold =
  140

>>  xr=xr-func(xr)/dfunc(xr)
xr =
 142.6903

>>  iter=iter+1
iter =
    1

>> ea=abs((xr-xrold)/xr)*100
ea =
   1.8854

>> ea <= es
ans =
    0

>> iter >= maxit
ans =
    0
```

$$e_a = \left| \frac{{x_r}^{new} - {x_r}^{old}}{{x_r}^{new}} \right| \times 100$$

$$e_t = \left| \frac{x_t - x_r}{x_t} \right| \times 100$$



$$e_a = \left| \frac{{x_r}^{new} - {x_r}^{old}}{{x_r}^{new}} \right| \times 100$$

$$e_t = \left| \frac{x_t - x_r}{x_t} \right| \times 100$$

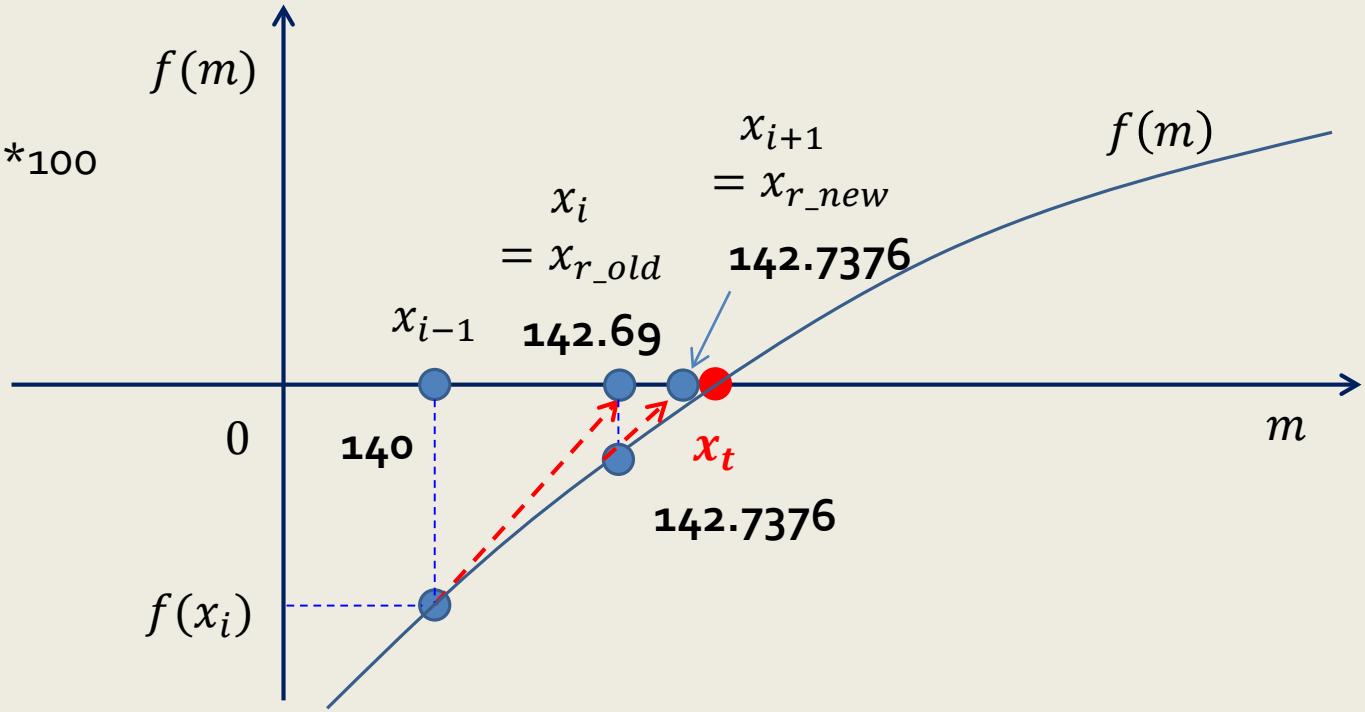
iter	xr_old	xr_new	ea	et
0	-	140	$\left\|\frac{140-\text{없음}}{140}\right\| \times 100$=값없음	$\left\|\frac{142.73-140}{142.73}\right\| \times 100$=19.13%
1	140	142.6903	$\left\|\frac{142.6903-140}{142.6903}\right\| \times 100 = 1.8854$	$\left\|\frac{142.73-142.6903}{142.73}\right\| \times 100 = 0.0278$

분석 (iter=2)

```
>> xrold=xr
xrold =
  142.6903  (old:140)

>>  xr=xr-func(xr)/dfunc(xr)
xr =
 142.7376   (old:142.6903)

>>  iter=iter+1
iter =
    2   (old:1)

>> ea=abs((xr-xrold)/xr)*100
ea =
   0.0331  (old:1.8854)

>> ea <= es
ans =
    0

>> iter >= maxit
ans =
    0
```

$$e_a = \left| \frac{x_r{}^{new} - x_r{}^{old}}{x_r{}^{new}} \right| \times 100$$

$$e_t = \left| \frac{x_t - x_r}{x_t} \right| \times 100$$

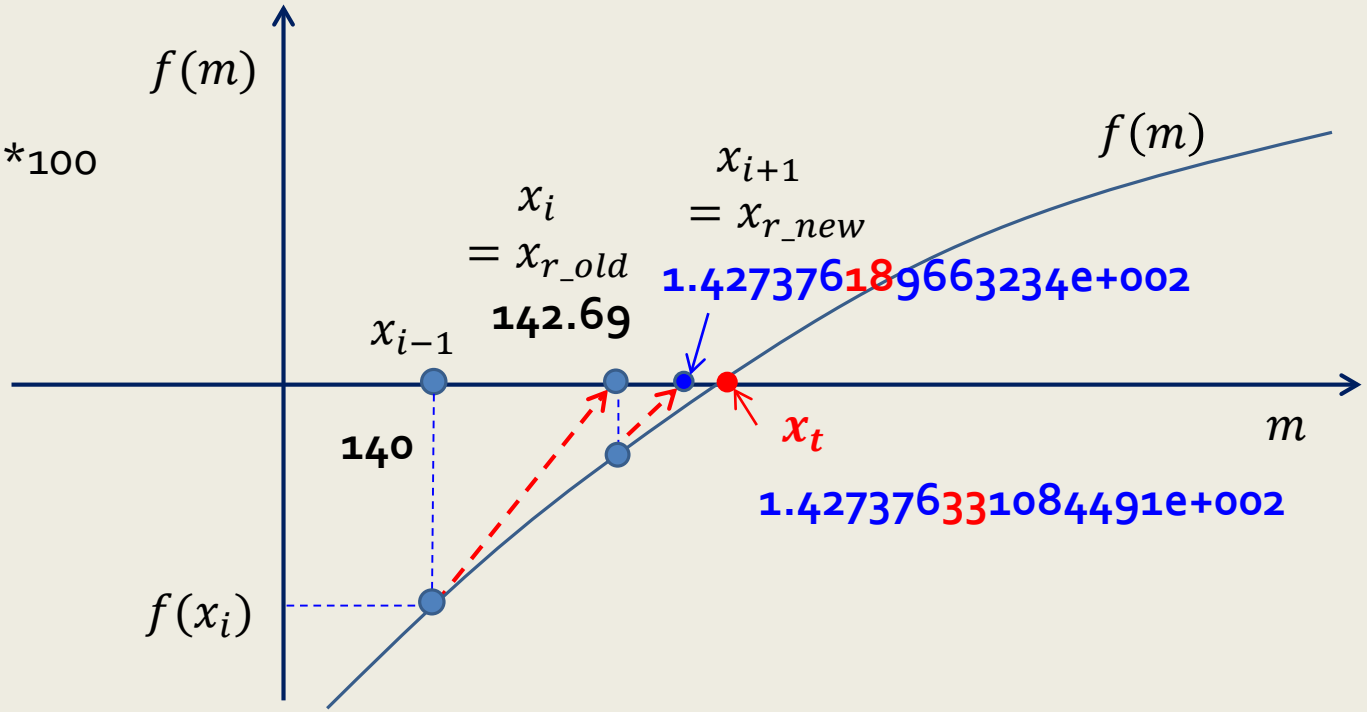


분석 (iter=2)

```
>> xrold=xr
xrold =
  142.6903  (old:140)

>>  xr=xr-func(xr)/dfunc(xr)
xr =
 142.7376   (old:142.6903)

>>  iter=iter+1
iter =
    2   (old:1)

>> ea=abs((xr-xrold)/xr)*100
ea =
   0.0331  (old:1.8854)

>> ea <= es
ans =
    0

>> iter >= maxit
ans =
    0
```

$$e_a = \left| \frac{x_r{}^{new} - x_r{}^{old}}{x_r{}^{new}} \right| \times 100$$

$$e_t = \left| \frac{x_t - x_r}{x_t} \right| \times 100$$

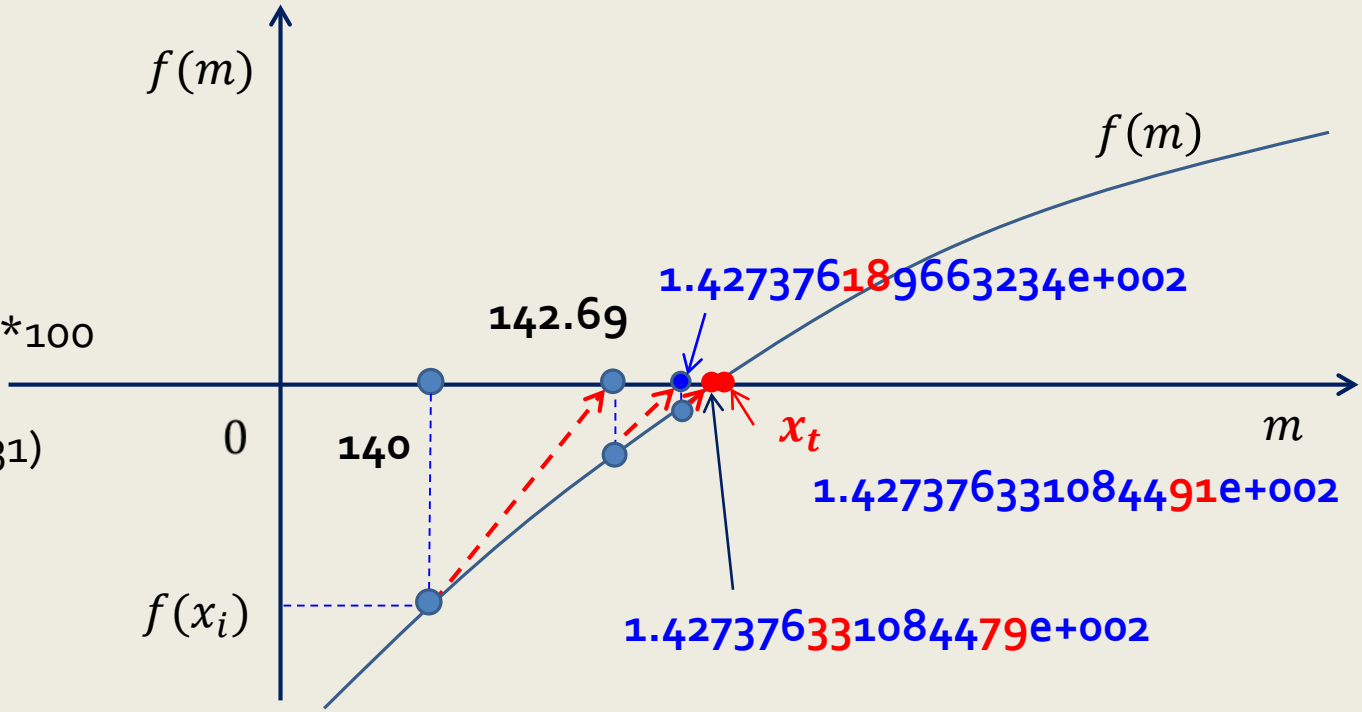


분석 (iter=3)

```
>> format long;
>>  xrold=xr
xrold =
1.427376189663234e+002   (old:
142.6903)

>>  xr=xr-func(xr)/dfunc(xr)
xr =
 1.427376331084479e+002    (old:
142.7376)

>>  iter=iter+1
iter =
    3   (old:2)

>> ea=abs((xr-xrold)/xr)*100
ea =
 9.9078e-006 (old: 0.0331)

>> ea <= es
ans =   1
>> iter >= maxit
ans =    0
```

$$e_a = \left| \frac{x_r{}^{new} - x_r{}^{old}}{x_r{}^{new}} \right| \times 100$$

$$e_t = \left| \frac{x_t - x_r}{x_t} \right| \times 100$$



$$e_a = \left|\frac{{x_r}^{new} - {x_r}^{old}}{{x_r}^{new}}\right| \times 100 \qquad e_t = \left|\frac{x_t - x_r}{x_t}\right| \times 100$$

iter	xr_old	xr_new	ea	et
0	-	140	$\left\|\frac{140-\text{없음}}{140}\right\| \times 100$=값없음	$\left\|\frac{142.73-140}{142.73}\right\| \times 100$=19.13%
1	140	142.6903	$\left\|\frac{142.6903-140}{142.6903}\right\| \times 100 = 1.8854$	$\left\|\frac{142.73-142.6903}{142.73}\right\| \times 100 = 0.0278$
2	142.6903	142.7376	$\left\|\frac{142.7376-142.6903}{142.7376}\right\| \times 100 = 0.0331$	$\left\|\frac{142.73-142.7376}{142.73}\right\| \times 100 = 0.0053$
3 format long	1.427376189663234e+002	1.427376331084479e+002	$\left\|\frac{1.427376331084479e+002 - 1.427376189663234e+002}{1.427376331084479e+002}\right\| \times 100 = 9.9078e-006$	$\left\|\frac{1.427376331084491e+002 - 1.427376331084479e+002}{1.427376331084491e+002}\right\| \times 100 = 8.3630e-013$

es = 1.0000e-005

fzero to get true root

```
[x, fx] = fzero(@(m) sqrt(9.81*m/0.25)*tanh(sqrt(9.81*0.25/m)*4)-36, 140)

x =

   1.427376331084491e+002


fx =

    0
```