Morse Coefficient Optimization

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In [1]:
```
printf(strftime ("Last updated: %A %e %B %Y", localtime (time ())))
```

```
Last updated: Sunday  8 December 2019
```

The notebook concerns itself with optimizing the detection coefficients $\phi_d(i)$ from `MorseCoefficients` notebook where $\phi_d(i)$ is is the i^{th} detection optimizing phase value for the message.

Turns out if M is the number of bits, then only have to optimize $\frac{M}{2}$ values, because for maximal detection, $\phi_d(i) = -\phi_d(M + 1 - i)$

The following function computes a column vector representing the sound/silence coefficients $a_s(i)$ for the message to be sent.

In [2]:
```
function A_s = makeMorseSoundSilence(message)
    baseCoeff = alphaToMorse(message)';
    A_s = vertcat(baseCoeff, [ 0; 0; 0; 0; 0; 0; 0; ], flip(baseCoeff));
    sz = rows(A_s);
    # See if needs padding
    if (sz < 551)
        half = (551 - sz)/2;
        A_s = vertcat(zeros(half,1), baseCoeff, [ 0; 0; 0; 0; 0; 0; 0; ], f
    endif
endfunction
```

Try it out

In [3]:
```
A_s = makeMorseSoundSilence("QRG DE VA3TYB VA3TYB?");
rows(A_s)
```

```
ans =  551
```

Determine the number of "on" bits.

In [4]:
```
A_s' * A_s
```

```
ans =  228
```

The following is the cost function used to optimize $\phi_d(i)$.

In [5]:
```
# Phi_d is a column vector, 0 <= phi <= pi, length m
# A_s is a column vector, 0 or 1s, length 2m + 1
function cost = costAny(Phi_d, A_s)
  # Make a test vector where the back half is a mirror and congugate of the
  # Centre value is 1, because it is the unit vector that is a congugate of
  test = A_s .* [ exp(j .* Phi_d); 1; exp(-j .* flip(Phi_d)) ];
  cost = max(abs(conv(test,flip(test))))/(A_s' * A_s);
endfunction
```

Try it out. Should get an answer between 0.15 and 0.5 but usually between 0.25 and 0.4.

In [6]:
```
costAny(pi .* rand(floor(rows(A_s)/2), 1), A_s)
```

```
ans =  0.24511
```

Ensure that you run `Nonlin_min_Install` notebook to install this package.

In [7]:
```
pkg load optim
```

Finally a function that will provide $a_s(i)$ and $\phi_d(i)$ for a given message.

In [8]:
```
function [A_s, Phi_d, objf, cvg] = optimize(message)
  A_s = makeMorseSoundSilence(message);
  m = floor(rows(A_s)/2);
  A_s_half = A_s(1:m);
  init_p = pi .* rand(m, 1) .* A_s_half;
  # Not varying all the parameters
  fixed = not(logical(A_s_half));
  lbound = zeros(m, 1);
  ubound = pi .* ones(m, 1);
  [Phi_d, objf, cvg] = nonlin_min (@ (Phi_trial) costAny(Phi_trial, A_s), i
    "fixed", fixed,
    "lbound", lbound,
    "ubound", ubound,
    "Display", "iter"
  ));
endfunction
```

Try it out.

In [9]:
```
[VA3ASE_A_s, VA3ASE_Phi_d, objf, cvg] = optimize("QRG DE VA3ASE VA3ASE?");
cvg
objf
```

```
temperature no. 1: 1.000000e-01, energy 3.367722e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
3688 / 5254 / 258 / 4537 / 7
temperature no. 2: 8.333333e-02, energy 2.919526e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
3610 / 5277 / 313 / 4611 / 1
temperature no. 3: 6.944444e-02, energy 2.409643e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
3570 / 5280 / 350 / 4583 / 4
temperature no. 4: 5.787037e-02, energy 3.231423e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
3539 / 5179 / 482 / 4677 / 0
temperature no. 5: 4.822531e-02, energy 2.897285e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
3474 / 5165 / 561 / 4572 / 0
temperature no. 6: 4.018776e-02, energy 2.288672e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
3475 / 5042 / 683 / 4615 / 0
temperature no. 7: 3.348980e-02, energy 2.643261e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
3340 / 5118 / 742 / 4555 / 1
temperature no. 8: 2.790816e-02, energy 3.139238e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
3338 / 4938 / 924 / 4559 / 1
temperature no. 9: 2.325680e-02, energy 2.377605e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
3231 / 4935 / 1034 / 4689 / 1
temperature no. 10: 1.938067e-02, energy 2.710122e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
3194 / 4686 / 1320 / 4609 / 0
temperature no. 11: 1.615056e-02, energy 2.675849e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
3039 / 4557 / 1604 / 4601 / 4
temperature no. 12: 1.345880e-02, energy 2.428999e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
2926 / 4455 / 1819 / 4555 / 8
temperature no. 13: 1.121567e-02, energy 1.937880e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
2772 / 4336 / 2092 / 4539 / 0
```

```
temperature no. 14: 9.346388e-03, energy 1.985827e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
2567 / 4141 / 2492 / 4471 / 4
temperature no. 15: 7.788657e-03, energy 2.229004e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
2439 / 3970 / 2791 / 4343 / 7
temperature no. 16: 6.490547e-03, energy 1.386240e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
2270 / 3748 / 3182 / 4238 / 11
temperature no. 17: 5.408789e-03, energy 1.513503e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
2119 / 3553 / 3528 / 3876 / 0
temperature no. 18: 4.507324e-03, energy 1.366228e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1883 / 3456 / 3861 / 3576 / 8
temperature no. 19: 3.756104e-03, energy 1.444153e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1858 / 3236 / 4106 / 3469 / 4
temperature no. 20: 3.130086e-03, energy 1.289693e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1753 / 3048 / 4399 / 3026 / 6
temperature no. 21: 2.608405e-03, energy 1.106580e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1592 / 3113 / 4495 / 2681 / 4
temperature no. 22: 2.173671e-03, energy 1.052592e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1470 / 3306 / 4424 / 2296 / 4
temperature no. 23: 1.811393e-03, energy 9.650896e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1390 / 3223 / 4587 / 2122 / 3
temperature no. 24: 1.509494e-03, energy 9.571838e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1337 / 3215 / 4648 / 1688 / 4
temperature no. 25: 1.257912e-03, energy 8.334371e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1288 / 3270 / 4642 / 1428 / 10
temperature no. 26: 1.048260e-03, energy 8.232185e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1323 / 3335 / 4542 / 1236 / 2
temperature no. 27: 8.735497e-04, energy 7.653316e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1195 / 3336 / 4669 / 1156 / 1
temperature no. 28: 7.279581e-04, energy 6.944102e-02,
```

```
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1108 / 3413 / 4679 / 1091 / 9
temperature no. 29: 6.066317e-04, energy 7.078823e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1092 / 3496 / 4612 / 871 / 4
temperature no. 30: 5.055264e-04, energy 6.074450e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1148 / 3365 / 4687 / 780 / 19
temperature no. 31: 4.212720e-04, energy 5.887798e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1089 / 3542 / 4569 / 730 / 6
temperature no. 32: 3.510600e-04, energy 5.957443e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1065 / 3423 / 4712 / 705 / 16
temperature no. 33: 2.925500e-04, energy 5.502896e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1035 / 3624 / 4541 / 590 / 9
temperature no. 34: 2.437917e-04, energy 5.551008e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
884 / 3656 / 4660 / 694 / 11
temperature no. 35: 2.031597e-04, energy 5.361233e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
795 / 3813 / 4592 / 644 / 17
temperature no. 36: 1.692998e-04, energy 5.023583e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
871 / 3641 / 4688 / 524 / 10
temperature no. 37: 1.410831e-04, energy 5.082939e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
803 / 3826 / 4571 / 648 / 28
temperature no. 38: 1.175693e-04, energy 4.926444e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
711 / 3813 / 4676 / 672 / 6
temperature no. 39: 9.797441e-05, energy 4.837373e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
668 / 3929 / 4603 / 673 / 12
temperature no. 40: 8.164534e-05, energy 4.838706e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
658 / 3939 / 4603 / 617 / 8
temperature no. 41: 6.803778e-05, energy 4.659178e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
584 / 3957 / 4659 / 597 / 36
temperature no. 42: 5.669815e-05, energy 4.589536e-02,
tries with energy less / not less but accepted / rejected: / to far / new
```

optimum
575 / 3975 / 4650 / 593 / 31
temperature no. 43: 4.724846e-05, energy 4.535450e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
633 / 3961 / 4606 / 625 / 17
temperature no. 44: 3.937372e-05, energy 4.458217e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
522 / 4085 / 4593 / 657 / 37
temperature no. 45: 3.281143e-05, energy 4.364354e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
521 / 3987 / 4692 / 664 / 47
temperature no. 46: 2.734286e-05, energy 4.320164e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
552 / 4046 / 4602 / 654 / 32
temperature no. 47: 2.278572e-05, energy 4.231829e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
538 / 4023 / 4639 / 752 / 52
temperature no. 48: 1.898810e-05, energy 4.211016e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
483 / 4131 / 4586 / 688 / 28
temperature no. 49: 1.582341e-05, energy 4.130656e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
499 / 3990 / 4711 / 746 / 63
temperature no. 50: 1.318618e-05, energy 4.110691e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
512 / 4038 / 4650 / 786 / 34
temperature no. 51: 1.098848e-05, energy 4.069702e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
504 / 4076 / 4620 / 769 / 52
temperature no. 52: 9.157068e-06, energy 4.045732e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
472 / 4141 / 4587 / 781 / 39
temperature no. 53: 7.630890e-06, energy 4.012932e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
428 / 4092 / 4680 / 818 / 63
temperature no. 54: 6.359075e-06, energy 3.986803e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
482 / 4045 / 4673 / 828 / 54
temperature no. 55: 5.299229e-06, energy 3.973923e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
452 / 4101 / 4647 / 751 / 52
temperature no. 56: 4.416024e-06, energy 3.953439e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum

```
558 / 3952 / 4690 / 768 / 56
temperature no. 57: 3.680020e-06, energy 3.943349e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
480 / 4098 / 4622 / 756 / 43
temperature no. 58: 3.066684e-06, energy 3.933116e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
505 / 4036 / 4659 / 779 / 36
temperature no. 59: 2.555570e-06, energy 3.925266e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
485 / 4136 / 4579 / 793 / 58
temperature no. 60: 2.129641e-06, energy 3.920243e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
544 / 3919 / 4737 / 785 / 44
temperature no. 61: 1.774701e-06, energy 3.917459e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
559 / 4068 / 4573 / 814 / 31
temperature no. 62: 1.478918e-06, energy 3.913133e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
554 / 4029 / 4617 / 745 / 44
temperature no. 63: 1.232431e-06, energy 3.911009e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
527 / 4034 / 4639 / 752 / 49
temperature no. 64: 1.027026e-06, energy 3.908774e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
509 / 4087 / 4604 / 748 / 5
temperature no. 65: 8.558551e-07, energy 3.906848e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
461 / 4117 / 4622 / 795 / 31
temperature no. 66: 7.132126e-07, energy 3.904646e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
458 / 4045 / 4697 / 845 / 56
temperature no. 67: 5.943438e-07, energy 3.903392e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
474 / 4182 / 4544 / 794 / 31
temperature no. 68: 4.952865e-07, energy 3.902689e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
429 / 4043 / 4728 / 800 / 49
temperature no. 69: 4.127388e-07, energy 3.901707e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
439 / 4137 / 4624 / 758 / 45
temperature no. 70: 3.439490e-07, energy 3.900552e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
441 / 4113 / 4646 / 841 / 43
```

```
temperature no. 71: 2.866241e-07, energy 3.900289e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
456 / 4197 / 4547 / 810 / 24
temperature no. 72: 2.388535e-07, energy 3.899289e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
450 / 4095 / 4655 / 795 / 69
temperature no. 73: 1.990445e-07, energy 3.898114e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
449 / 4090 / 4661 / 840 / 82
temperature no. 74: 1.658705e-07, energy 3.897836e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
520 / 3909 / 4771 / 790 / 48
temperature no. 75: 1.382254e-07, energy 3.897443e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
595 / 3994 / 4611 / 820 / 54
temperature no. 76: 1.151878e-07, energy 3.897307e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
569 / 4060 / 4571 / 817 / 37
temperature no. 77: 9.598985e-08, energy 3.897153e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
452 / 4222 / 4526 / 741 / 17
temperature no. 78: 7.999154e-08, energy 3.896930e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
414 / 4065 / 4721 / 786 / 38
temperature no. 79: 6.665962e-08, energy 3.896552e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
478 / 4073 / 4649 / 856 / 103
temperature no. 80: 5.554968e-08, energy 3.896454e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
479 / 4101 / 4620 / 827 / 43
temperature no. 81: 4.629140e-08, energy 3.896291e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
469 / 4068 / 4663 / 813 / 47
temperature no. 82: 3.857617e-08, energy 3.896179e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
486 / 4088 / 4626 / 848 / 62
temperature no. 83: 3.214681e-08, energy 3.896162e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
525 / 4028 / 4647 / 803 / 19
temperature no. 84: 2.678900e-08, energy 3.896139e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
431 / 4230 / 4539 / 805 / 7
temperature no. 85: 2.232417e-08, energy 3.896079e-02,
```

```
tries with energy less / not less but accepted / rejected: / to far / new
optimum
401 / 4166 / 4633 / 828 / 53
temperature no. 86: 1.860348e-08, energy 3.895991e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
400 / 4066 / 4734 / 899 / 91
temperature no. 87: 1.550290e-08, energy 3.895900e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
441 / 4138 / 4621 / 805 / 94
temperature no. 88: 1.291908e-08, energy 3.895860e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
483 / 4074 / 4643 / 802 / 75
samin: convergence near bounds
objective function: 3.895853e-02
parameter #1, value: 3.141590e+00, search width: 1.137565e-05
parameter #2, value: 1.523111e+00, search width: 1.439731e-05
parameter #3, value: 9.742736e-01, search width: 2.244508e-05
parameter #4, value: 3.141592e+00, search width: 7.583767e-06
parameter #5, value: 3.141591e+00, search width: 5.055845e-06
parameter #6, value: 3.141576e+00, search width: 1.968264e-05
parameter #7, value: 3.141586e+00, search width: 2.802470e-05
parameter #8, value: 3.141562e+00, search width: 3.412695e-05
parameter #9, value: 2.024576e+00, search width: 1.245542e-05
parameter #10, value: 2.272890e+00, search width: 5.687825e-06
parameter #11, value: 3.141582e+00, search width: 2.992677e-05
parameter #12, value: 3.141587e+00, search width: 7.093753e-05
parameter #13, value: 9.048298e-01, search width: 2.840705e-05
parameter #14, value: 3.141525e+00, search width: 2.879462e-05
parameter #15, value: 3.141573e+00, search width: 2.101853e-05
parameter #16, value: 1.141955e+00, search width: 5.911461e-06
parameter #17, value: 3.141561e+00, search width: 3.412695e-05
parameter #18, value: 4.170844e-06, search width: 1.137565e-05
parameter #19, value: 1.935279e+00, search width: 2.396845e-05
parameter #20, value: 1.325786e+00, search width: 2.764750e-05
parameter #21, value: 1.400569e+00, search width: 2.660157e-05
parameter #22, value: 3.141591e+00, search width: 4.489016e-05
parameter #23, value: 1.486270e+00, search width: 6.067014e-05
parameter #24, value: 1.761219e+00, search width: 3.321446e-05
parameter #25, value: 3.141556e+00, search width: 1.995118e-05
parameter #26, value: 1.997694e+00, search width: 1.576390e-05
parameter #27, value: 8.143831e-01, search width: 4.203705e-05
parameter #28, value: 3.141592e+00, search width: 3.152779e-05
parameter #29, value: 3.141581e+00, search width: 4.793690e-05
parameter #30, value: 1.800908e+00, search width: 4.489016e-05
parameter #31, value: 1.175813e+00, search width: 1.137565e-05
parameter #32, value: 1.285249e+00, search width: 4.319192e-05
parameter #33, value: 3.368358e-05, search width: 7.980472e-05
parameter #34, value: 1.006633e+00, search width: 3.736627e-05
parameter #35, value: 2.009787e+00, search width: 2.559521e-05
parameter #36, value: 1.150823e+00, search width: 2.840705e-05
parameter #37, value: 3.141577e+00, search width: 2.493898e-06
parameter #38, value: 1.723209e+00, search width: 5.050143e-05
parameter #39, value: 3.141524e+00, search width: 8.978031e-05
parameter #40, value: 1.552933e+00, search width: 8.522115e-05
```

```
parameter #41, value: 7.278811e-08, search width: 2.022338e-05
parameter #42, value: 1.476604e+00, search width: 4.489016e-05
parameter #43, value: 1.117321e+00, search width: 5.904793e-05
parameter #44, value: 1.025300e-05, search width: 1.180959e-04
parameter #45, value: 1.337532e+00, search width: 3.195793e-05
parameter #46, value: 1.528445e+00, search width: 5.681410e-05
parameter #47, value: 1.043332e-06, search width: 1.773438e-05
parameter #48, value: 1.394025e+00, search width: 3.499137e-05
parameter #49, value: 1.352669e+00, search width: 3.239394e-05
parameter #50, value: 4.880342e-05, search width: 1.120988e-04
parameter #51, value: 1.432010e+00, search width: 9.458337e-05
parameter #52, value: 1.512360e+00, search width: 5.604941e-05
parameter #53, value: 1.231379e+00, search width: 1.418751e-04
parameter #54, value: 4.506400e-01, search width: 4.793690e-05
parameter #55, value: 1.189704e+00, search width: 3.595267e-05
parameter #56, value: 9.294630e-01, search width: 3.839282e-05
parameter #57, value: 1.304437e+00, search width: 1.213403e-04
parameter #58, value: 1.377144e+00, search width: 4.729169e-05
parameter #59, value: 1.227891e+00, search width: 1.617870e-04
parameter #60, value: 1.005819e-06, search width: 8.867191e-06
parameter #61, value: 7.281934e-06, search width: 3.736627e-05
parameter #62, value: 1.762957e-04, search width: 1.078580e-04
parameter #63, value: 7.440289e-01, search width: 7.575214e-05
parameter #64, value: 1.184536e+00, search width: 4.147125e-05
parameter #65, value: 9.410521e-01, search width: 5.320315e-05
parameter #66, value: 1.328978e+00, search width: 1.064063e-04
parameter #67, value: 1.095289e+00, search width: 5.320315e-05
parameter #68, value: 9.161283e-05, search width: 1.064063e-04
parameter #69, value: 6.827168e-06, search width: 2.525071e-05
parameter #70, value: 9.027706e-01, search width: 1.262536e-05
parameter #71, value: 9.628497e-06, search width: 1.064063e-04
parameter #72, value: 7.175350e-01, search width: 2.840705e-05
parameter #73, value: 1.460250e-05, search width: 5.985354e-05
parameter #74, value: 3.397350e-05, search width: 2.879462e-05
parameter #75, value: 5.190215e-01, search width: 7.093753e-05
parameter #76, value: 1.401931e+00, search width: 3.936529e-05
parameter #77, value: 1.032334e+00, search width: 1.597897e-05
parameter #78, value: 7.338751e-01, search width: 5.985354e-05
parameter #79, value: 3.691699e-01, search width: 5.604941e-05
parameter #80, value: 5.924588e-06, search width: 1.868314e-05
parameter #81, value: 1.126109e+00, search width: 3.736627e-05
parameter #82, value: 2.294754e-05, search width: 6.067014e-05
parameter #83, value: 8.528007e-01, search width: 1.330079e-05
parameter #84, value: 3.320821e-01, search width: 2.802470e-05
parameter #85, value: 6.628438e-01, search width: 5.604941e-05
parameter #86, value: 1.123897e+00, search width: 1.893803e-05
parameter #87, value: 2.473588e-01, search width: 4.729169e-05
parameter #88, value: 1.065229e+00, search width: 9.587380e-05
parameter #89, value: 1.141992e+00, search width: 1.365078e-04
parameter #90, value: 5.604489e-01, search width: 3.936529e-05
parameter #91, value: 1.075544e+00, search width: 6.998274e-05
parameter #92, value: 1.164144e+00, search width: 6.733523e-05
cvg =  1
objf =  0.038959
```

In [10]:
```
[VE3YRA_A_s, VE3YRA_Phi_d, objf, cvg] = optimize("QRG DE VE3YRA VE3YRA?");
cvg
objf
```

```
temperature no. 1: 1.000000e-01, energy 3.266923e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
4392 / 6146 / 262 / 5372 / 34
temperature no. 2: 8.333333e-02, energy 3.324721e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
4357 / 6114 / 329 / 5350 / 2
temperature no. 3: 6.944444e-02, energy 2.693990e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
4361 / 6056 / 383 / 5365 / 0
temperature no. 4: 5.787037e-02, energy 2.764007e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
4280 / 6058 / 462 / 5417 / 1
temperature no. 5: 4.822531e-02, energy 2.720499e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
4285 / 5941 / 574 / 5392 / 0
temperature no. 6: 4.018776e-02, energy 2.827759e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
4137 / 5987 / 676 / 5372 / 2
temperature no. 7: 3.348980e-02, energy 2.540212e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
4149 / 5836 / 815 / 5411 / 2
temperature no. 8: 2.790816e-02, energy 2.692560e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
3972 / 5893 / 935 / 5417 / 5
temperature no. 9: 2.325680e-02, energy 2.668611e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
3931 / 5719 / 1150 / 5334 / 2
temperature no. 10: 1.938067e-02, energy 2.543197e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
3831 / 5621 / 1348 / 5326 / 4
temperature no. 11: 1.615056e-02, energy 2.308035e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
3731 / 5495 / 1574 / 5409 / 0
temperature no. 12: 1.345880e-02, energy 2.727892e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
3607 / 5233 / 1960 / 5276 / 6
temperature no. 13: 1.121567e-02, energy 2.495679e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
3415 / 5132 / 2253 / 5380 / 8
```

```
temperature no. 14: 9.346388e-03, energy 2.543861e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
3258 / 4897 / 2645 / 5217 / 2
temperature no. 15: 7.788657e-03, energy 2.349666e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
3042 / 4737 / 3021 / 5290 / 5
temperature no. 16: 6.490547e-03, energy 2.150786e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
2881 / 4503 / 3416 / 5026 / 0
temperature no. 17: 5.408789e-03, energy 2.084666e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
2675 / 4320 / 3805 / 4955 / 3
temperature no. 18: 4.507324e-03, energy 1.247639e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
2479 / 3907 / 4414 / 4455 / 6
temperature no. 19: 3.756104e-03, energy 1.178467e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
2281 / 3868 / 4651 / 4159 / 13
temperature no. 20: 3.130086e-03, energy 1.238974e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
2187 / 3588 / 5025 / 3666 / 2
temperature no. 21: 2.608405e-03, energy 1.267142e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
2065 / 3641 / 5094 / 3329 / 13
temperature no. 22: 2.173671e-03, energy 9.747517e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1927 / 3434 / 5439 / 2758 / 4
temperature no. 23: 1.811393e-03, energy 8.371150e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1843 / 3620 / 5337 / 2464 / 0
temperature no. 24: 1.509494e-03, energy 7.916957e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1800 / 3605 / 5395 / 2222 / 7
temperature no. 25: 1.257912e-03, energy 8.791301e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1691 / 3742 / 5367 / 1777 / 2
temperature no. 26: 1.048260e-03, energy 7.892304e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1561 / 3707 / 5532 / 1567 / 6
temperature no. 27: 8.735497e-04, energy 7.668561e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1589 / 3761 / 5450 / 1306 / 5
temperature no. 28: 7.279581e-04, energy 6.247590e-02,
```

```
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1502 / 3890 / 5408 / 1170 / 5
temperature no. 29: 6.066317e-04, energy 6.754727e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1476 / 3813 / 5511 / 1084 / 4
temperature no. 30: 5.055264e-04, energy 6.461690e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1430 / 3911 / 5459 / 963 / 14
temperature no. 31: 4.212720e-04, energy 6.111327e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1336 / 4101 / 5363 / 859 / 2
temperature no. 32: 3.510600e-04, energy 5.991262e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1246 / 4052 / 5502 / 818 / 9
temperature no. 33: 2.925500e-04, energy 5.229725e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1321 / 4119 / 5360 / 764 / 27
temperature no. 34: 2.437917e-04, energy 5.499666e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1311 / 4014 / 5475 / 716 / 8
temperature no. 35: 2.031597e-04, energy 5.099947e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1099 / 4285 / 5416 / 709 / 20
temperature no. 36: 1.692998e-04, energy 4.865371e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1266 / 4071 / 5463 / 745 / 35
temperature no. 37: 1.410831e-04, energy 4.666783e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1253 / 4177 / 5370 / 689 / 10
temperature no. 38: 1.175693e-04, energy 4.433054e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1256 / 4113 / 5431 / 696 / 29
temperature no. 39: 9.797441e-05, energy 4.501538e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1205 / 4278 / 5317 / 666 / 45
temperature no. 40: 8.164534e-05, energy 4.192576e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1028 / 4256 / 5516 / 754 / 14
temperature no. 41: 6.803778e-05, energy 4.072543e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
950 / 4445 / 5405 / 781 / 24
temperature no. 42: 5.669815e-05, energy 4.043934e-02,
tries with energy less / not less but accepted / rejected: / to far / new
```

optimum
804 / 4576 / 5420 / 794 / 22
temperature no. 43: 4.724846e-05, energy 4.028206e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
758 / 4608 / 5434 / 821 / 6
temperature no. 44: 3.937372e-05, energy 3.956718e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
698 / 4666 / 5436 / 782 / 10
temperature no. 45: 3.281143e-05, energy 3.878129e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
760 / 4605 / 5435 / 737 / 30
temperature no. 46: 2.734286e-05, energy 3.842064e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
780 / 4629 / 5391 / 801 / 59
temperature no. 47: 2.278572e-05, energy 3.755743e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
798 / 4438 / 5564 / 856 / 48
temperature no. 48: 1.898810e-05, energy 3.680328e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
890 / 4460 / 5450 / 776 / 47
temperature no. 49: 1.582341e-05, energy 3.694852e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
866 / 4599 / 5335 / 820 / 20
temperature no. 50: 1.318618e-05, energy 3.655344e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
768 / 4579 / 5453 / 814 / 10
temperature no. 51: 1.098848e-05, energy 3.633470e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
863 / 4472 / 5465 / 785 / 42
temperature no. 52: 9.157068e-06, energy 3.617769e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
879 / 4428 / 5493 / 796 / 34
temperature no. 53: 7.630890e-06, energy 3.610147e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
780 / 4623 / 5397 / 811 / 23
temperature no. 54: 6.359075e-06, energy 3.610770e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
793 / 4580 / 5427 / 743 / 11
temperature no. 55: 5.299229e-06, energy 3.588477e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
755 / 4646 / 5399 / 788 / 62
temperature no. 56: 4.416024e-06, energy 3.570127e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum

681 / 4677 / 5442 / 806 / 79
temperature no. 57: 3.680020e-06, energy 3.560095e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
672 / 4710 / 5418 / 744 / 42
temperature no. 58: 3.066684e-06, energy 3.547185e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
667 / 4695 / 5438 / 746 / 47
temperature no. 59: 2.555570e-06, energy 3.539449e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
597 / 4800 / 5403 / 792 / 49
temperature no. 60: 2.129641e-06, energy 3.532593e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
593 / 4742 / 5465 / 784 / 54
temperature no. 61: 1.774701e-06, energy 3.522804e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
652 / 4673 / 5475 / 790 / 86
temperature no. 62: 1.478918e-06, energy 3.517885e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
674 / 4685 / 5441 / 707 / 71
temperature no. 63: 1.232431e-06, energy 3.515500e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
587 / 4783 / 5430 / 729 / 57
temperature no. 64: 1.027026e-06, energy 3.512429e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
585 / 4798 / 5417 / 698 / 47
temperature no. 65: 8.558551e-07, energy 3.510340e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
633 / 4758 / 5409 / 667 / 57
temperature no. 66: 7.132126e-07, energy 3.507924e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
709 / 4640 / 5451 / 722 / 50
temperature no. 67: 5.943438e-07, energy 3.505048e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
561 / 4838 / 5401 / 735 / 42
temperature no. 68: 4.952865e-07, energy 3.503023e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
591 / 4724 / 5485 / 668 / 56
temperature no. 69: 4.127388e-07, energy 3.500907e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
652 / 4561 / 5587 / 714 / 85
temperature no. 70: 3.439490e-07, energy 3.499849e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
604 / 4866 / 5330 / 709 / 44

```
temperature no. 71: 2.866241e-07, energy 3.498989e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
684 / 4649 / 5467 / 579 / 51
temperature no. 72: 2.388535e-07, energy 3.497764e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
647 / 4805 / 5348 / 717 / 86
temperature no. 73: 1.990445e-07, energy 3.496812e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
597 / 4798 / 5405 / 694 / 74
temperature no. 74: 1.658705e-07, energy 3.496225e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
658 / 4668 / 5474 / 648 / 56
temperature no. 75: 1.382254e-07, energy 3.495693e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
603 / 4660 / 5537 / 745 / 52
temperature no. 76: 1.151878e-07, energy 3.495109e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
571 / 4832 / 5397 / 715 / 75
temperature no. 77: 9.598985e-08, energy 3.494585e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
684 / 4647 / 5469 / 666 / 82
temperature no. 78: 7.999154e-08, energy 3.494275e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
551 / 4849 / 5400 / 729 / 74
temperature no. 79: 6.665962e-08, energy 3.493924e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
535 / 4873 / 5392 / 715 / 90
temperature no. 80: 5.554968e-08, energy 3.493652e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
498 / 4787 / 5515 / 716 / 73
temperature no. 81: 4.629140e-08, energy 3.493365e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
507 / 4874 / 5419 / 705 / 93
temperature no. 82: 3.857617e-08, energy 3.493043e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
555 / 4847 / 5398 / 676 / 107
temperature no. 83: 3.214681e-08, energy 3.492911e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
512 / 4784 / 5504 / 736 / 87
temperature no. 84: 2.678900e-08, energy 3.492788e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
540 / 4916 / 5344 / 769 / 59
temperature no. 85: 2.232417e-08, energy 3.492611e-02,
```

```
tries with energy less / not less but accepted / rejected: / to far / new
optimum
481 / 4862 / 5457 / 714 / 112
temperature no. 86: 1.860348e-08, energy 3.492398e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
445 / 4988 / 5367 / 772 / 153
temperature no. 87: 1.550290e-08, energy 3.492141e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
383 / 4862 / 5555 / 726 / 175
temperature no. 88: 1.291908e-08, energy 3.492014e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
428 / 4871 / 5501 / 677 / 131
temperature no. 89: 1.076590e-08, energy 3.491933e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
461 / 4900 / 5439 / 644 / 126
temperature no. 90: 8.971583e-09, energy 3.491811e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
427 / 4903 / 5470 / 708 / 162
temperature no. 91: 7.476320e-09, energy 3.491709e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
466 / 4984 / 5350 / 669 / 133
temperature no. 92: 6.230266e-09, energy 3.491643e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
472 / 4782 / 5546 / 701 / 131
temperature no. 93: 5.191889e-09, energy 3.491617e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
497 / 4867 / 5436 / 636 / 74
temperature no. 94: 4.326574e-09, energy 3.491577e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
433 / 4988 / 5379 / 652 / 123
temperature no. 95: 3.605478e-09, energy 3.491543e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
508 / 4777 / 5515 / 660 / 147
temperature no. 96: 3.004565e-09, energy 3.491529e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
542 / 4811 / 5447 / 648 / 56
samin: convergence near bounds
objective function: 3.491527e-02
parameter #1, value: 3.141590e+00, search width: 4.049243e-06
parameter #2, value: 1.763972e+00, search width: 1.348225e-05
parameter #3, value: 2.024389e+00, search width: 8.541372e-07
parameter #4, value: 1.760923e+00, search width: 1.421956e-06
parameter #5, value: 3.141586e+00, search width: 1.313658e-06
parameter #6, value: 3.141582e+00, search width: 7.481693e-06
parameter #7, value: 2.191804e+00, search width: 4.494084e-06
parameter #8, value: 3.141592e+00, search width: 4.494084e-06
```

```
parameter #9, value: 1.748456e+00, search width: 3.791884e-06
parameter #10, value: 2.270076e+00, search width: 1.402817e-06
parameter #11, value: 3.141538e+00, search width: 1.036781e-05
parameter #12, value: 3.141593e+00, search width: 6.657903e-07
parameter #13, value: 3.141417e+00, search width: 1.120988e-04
parameter #14, value: 3.141592e+00, search width: 7.592331e-07
parameter #15, value: 3.141587e+00, search width: 5.911461e-06
parameter #16, value: 3.141212e+00, search width: 6.650393e-06
parameter #17, value: 1.399527e+00, search width: 1.182292e-05
parameter #18, value: 5.884739e-01, search width: 1.037952e-06
parameter #19, value: 3.025188e-08, search width: 1.775441e-06
parameter #20, value: 3.141591e+00, search width: 8.877204e-07
parameter #21, value: 2.286211e+00, search width: 3.690496e-06
parameter #22, value: 3.141593e+00, search width: 8.312992e-07
parameter #23, value: 3.141575e+00, search width: 7.006176e-06
parameter #24, value: 3.141553e+00, search width: 6.741127e-06
parameter #25, value: 2.036098e+00, search width: 8.867191e-06
parameter #26, value: 2.158724e+00, search width: 9.341568e-06
parameter #27, value: 1.530293e+00, search width: 9.975590e-06
parameter #28, value: 9.933060e-06, search width: 1.401235e-05
parameter #29, value: 1.329754e+00, search width: 1.198422e-05
parameter #30, value: 1.895366e+00, search width: 5.535744e-06
parameter #31, value: 1.260747e+00, search width: 7.881948e-06
parameter #32, value: 1.663942e+00, search width: 1.749568e-05
parameter #33, value: 1.533968e+00, search width: 1.050926e-05
parameter #34, value: 6.285252e-06, search width: 1.330079e-05
parameter #35, value: 1.487932e+00, search width: 1.995118e-05
parameter #36, value: 3.141588e+00, search width: 1.198422e-05
parameter #37, value: 1.432522e+00, search width: 1.198422e-05
parameter #38, value: 1.995248e+00, search width: 8.416904e-06
parameter #39, value: 1.621497e+00, search width: 1.476198e-05
parameter #40, value: 1.778627e+00, search width: 3.736627e-05
parameter #41, value: 7.757463e-06, search width: 1.065264e-05
parameter #42, value: 1.831765e+00, search width: 6.560882e-06
parameter #43, value: 1.708232e+00, search width: 2.130529e-05
parameter #44, value: 3.446970e-06, search width: 1.968264e-05
parameter #45, value: 1.274543e+00, search width: 1.496339e-05
parameter #46, value: 2.241071e-02, search width: 2.525071e-05
parameter #47, value: 1.644585e+00, search width: 5.055845e-06
parameter #48, value: 1.594624e+00, search width: 7.380992e-06
parameter #49, value: 1.623231e+00, search width: 1.597897e-05
parameter #50, value: 1.132821e+00, search width: 1.893803e-05
parameter #51, value: 1.437947e-07, search width: 3.321446e-05
parameter #52, value: 1.063801e+00, search width: 7.281646e-06
parameter #53, value: 1.562622e-05, search width: 2.130529e-05
parameter #54, value: 1.512109e+00, search width: 1.401235e-05
parameter #55, value: 5.361535e-06, search width: 2.022338e-05
parameter #56, value: 3.141568e+00, search width: 8.098486e-06
parameter #57, value: 1.734606e+00, search width: 1.420353e-05
parameter #58, value: 1.546900e+00, search width: 3.787607e-05
parameter #59, value: 3.141580e+00, search width: 2.491085e-05
parameter #60, value: 1.295315e-05, search width: 3.936529e-05
parameter #61, value: 1.442493e+00, search width: 2.275130e-05
parameter #62, value: 7.258545e-01, search width: 1.893803e-05
parameter #63, value: 5.470581e-06, search width: 1.919641e-05
parameter #64, value: 3.022305e-06, search width: 3.366762e-05
parameter #65, value: 1.081043e+00, search width: 3.791884e-06
```

```
parameter #66, value: 8.729606e-01, search width: 2.396845e-05
parameter #67, value: 1.135987e+00, search width: 1.330079e-05
parameter #68, value: 5.360802e-04, search width: 1.278317e-04
parameter #69, value: 5.101241e-08, search width: 7.101763e-06
parameter #70, value: 7.671564e-01, search width: 4.373921e-06
parameter #71, value: 9.389424e-01, search width: 1.597897e-05
parameter #72, value: 8.858471e-01, search width: 2.491085e-05
parameter #73, value: 1.130653e+00, search width: 1.107149e-05
parameter #74, value: 1.059775e-04, search width: 9.718183e-05
parameter #75, value: 1.110515e+00, search width: 1.683381e-05
parameter #76, value: 7.218070e-06, search width: 1.401235e-05
parameter #77, value: 1.299182e+00, search width: 9.598206e-06
parameter #78, value: 7.317086e-01, search width: 1.439731e-05
parameter #79, value: 1.075659e-05, search width: 1.706348e-05
parameter #80, value: 1.417412e+00, search width: 1.706348e-05
parameter #81, value: 9.057014e-01, search width: 3.936529e-05
parameter #82, value: 7.442836e-02, search width: 1.893803e-05
parameter #83, value: 1.600605e+00, search width: 1.660723e-05
parameter #84, value: 1.264791e+00, search width: 1.420353e-05
parameter #85, value: 1.179378e+00, search width: 3.033507e-05
parameter #86, value: 4.978136e-02, search width: 2.992677e-05
parameter #87, value: 1.174022e+00, search width: 1.773438e-05
parameter #88, value: 7.987778e-01, search width: 1.137565e-05
parameter #89, value: 1.957533e-05, search width: 4.729169e-05
parameter #90, value: 5.527263e-01, search width: 8.867191e-06
parameter #91, value: 7.481545e-01, search width: 2.244508e-05
parameter #92, value: 8.665829e-01, search width: 3.033507e-05
parameter #93, value: 3.657410e-01, search width: 1.576390e-05
parameter #94, value: 1.085131e+00, search width: 1.214773e-05
parameter #95, value: 3.755481e-01, search width: 1.107149e-05
parameter #96, value: 1.719021e-01, search width: 1.214773e-05
parameter #97, value: 7.641570e-01, search width: 2.429546e-05
parameter #98, value: 7.076772e-01, search width: 1.893803e-05
parameter #99, value: 9.351619e-01, search width: 1.330079e-05
parameter #100, value: 5.423811e-03, search width: 1.198422e-05
parameter #101, value: 1.243967e+00, search width: 1.348225e-05
parameter #102, value: 9.706949e-01, search width: 3.546876e-05
parameter #103, value: 7.438681e-01, search width: 7.989483e-06
parameter #104, value: 1.165205e+00, search width: 3.595267e-05
parameter #105, value: 1.018311e+00, search width: 1.010029e-04
parameter #106, value: 6.570234e-01, search width: 2.244508e-05
parameter #107, value: 4.415267e-01, search width: 1.868314e-05
parameter #108, value: 1.079993e+00, search width: 1.660723e-05
cvg =  1
objf =  0.034915
```

In [11]:
```
[VA3TYB_A_s, VA3TYB_Phi_d, objf, cvg] = optimize("QRG DE VA3TYB VA3TYB?");
cvg
objf
```

```
temperature no. 1: 1.000000e-01, energy 3.040297e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
4737 / 6378 / 285 / 5620 / 2
temperature no. 2: 8.333333e-02, energy 3.233347e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
4664 / 6408 / 328 / 5665 / 11
temperature no. 3: 6.944444e-02, energy 3.429063e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
4652 / 6391 / 357 / 5713 / 3
temperature no. 4: 5.787037e-02, energy 3.164613e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
4517 / 6402 / 481 / 5628 / 0
temperature no. 5: 4.822531e-02, energy 2.331059e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
4579 / 6289 / 532 / 5678 / 0
temperature no. 6: 4.018776e-02, energy 2.658711e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
4476 / 6255 / 669 / 5711 / 1
temperature no. 7: 3.348980e-02, energy 3.148210e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
4514 / 6128 / 758 / 5737 / 1
temperature no. 8: 2.790816e-02, energy 3.069026e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
4334 / 6122 / 944 / 5660 / 1
temperature no. 9: 2.325680e-02, energy 2.822264e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
4213 / 6012 / 1175 / 5692 / 0
temperature no. 10: 1.938067e-02, energy 2.667655e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
4131 / 5981 / 1288 / 5728 / 0
temperature no. 11: 1.615056e-02, energy 2.576012e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
4024 / 5748 / 1628 / 5718 / 0
temperature no. 12: 1.345880e-02, energy 2.177049e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
3869 / 5618 / 1913 / 5712 / 3
temperature no. 13: 1.121567e-02, energy 2.467037e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
3673 / 5495 / 2232 / 5614 / 2
temperature no. 14: 9.346388e-03, energy 1.970140e-01,
```

```
tries with energy less / not less but accepted / rejected: / to far / new
optimum
3565 / 5230 / 2605 / 5563 / 9
temperature no. 15: 7.788657e-03, energy 1.633474e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
3272 / 5048 / 3080 / 5539 / 5
temperature no. 16: 6.490547e-03, energy 1.976806e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
3101 / 4882 / 3417 / 5431 / 0
temperature no. 17: 5.408789e-03, energy 1.847887e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
2809 / 4606 / 3985 / 5206 / 3
temperature no. 18: 4.507324e-03, energy 1.272531e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
2584 / 4269 / 4547 / 4865 / 2
temperature no. 19: 3.756104e-03, energy 1.138675e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
2528 / 3950 / 4922 / 4516 / 3
temperature no. 20: 3.130086e-03, energy 1.129258e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
2357 / 3837 / 5206 / 4106 / 0
temperature no. 21: 2.608405e-03, energy 1.112540e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
2128 / 3852 / 5420 / 3799 / 2
temperature no. 22: 2.173671e-03, energy 9.871719e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
2017 / 3749 / 5634 / 3155 / 11
temperature no. 23: 1.811393e-03, energy 1.131277e-01,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1940 / 3913 / 5547 / 2545 / 18
temperature no. 24: 1.509494e-03, energy 8.178692e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1811 / 3816 / 5773 / 2391 / 2
temperature no. 25: 1.257912e-03, energy 7.794963e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1819 / 3894 / 5687 / 1888 / 4
temperature no. 26: 1.048260e-03, energy 8.123841e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1661 / 4033 / 5706 / 1634 / 0
temperature no. 27: 8.735497e-04, energy 7.582691e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1719 / 3911 / 5770 / 1448 / 3
temperature no. 28: 7.279581e-04, energy 6.729127e-02,
tries with energy less / not less but accepted / rejected: / to far / new
```

optimum
1608 / 4038 / 5754 / 1318 / 25
temperature no. 29: 6.066317e-04, energy 6.678162e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1539 / 4148 / 5713 / 1132 / 2
temperature no. 30: 5.055264e-04, energy 6.251322e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1430 / 4305 / 5665 / 975 / 1
temperature no. 31: 4.212720e-04, energy 6.448844e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1517 / 4162 / 5721 / 869 / 9
temperature no. 32: 3.510600e-04, energy 5.860075e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1374 / 4249 / 5777 / 865 / 6
temperature no. 33: 2.925500e-04, energy 5.371702e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1371 / 4351 / 5678 / 814 / 19
temperature no. 34: 2.437917e-04, energy 4.995264e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1392 / 4230 / 5778 / 843 / 28
temperature no. 35: 2.031597e-04, energy 4.917355e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1491 / 4139 / 5770 / 721 / 13
temperature no. 36: 1.692998e-04, energy 4.733261e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1341 / 4290 / 5769 / 790 / 15
temperature no. 37: 1.410831e-04, energy 4.553738e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1186 / 4462 / 5752 / 802 / 18
temperature no. 38: 1.175693e-04, energy 4.509286e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1211 / 4503 / 5686 / 836 / 24
temperature no. 39: 9.797441e-05, energy 4.231660e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1187 / 4446 / 5767 / 797 / 27
temperature no. 40: 8.164534e-05, energy 4.274189e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1135 / 4508 / 5757 / 768 / 5
temperature no. 41: 6.803778e-05, energy 4.289311e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
1014 / 4770 / 5616 / 774 / 28
temperature no. 42: 5.669815e-05, energy 4.180132e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum

890 / 4733 / 5777 / 793 / 0
temperature no. 43: 4.724846e-05, energy 4.198436e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
859 / 4837 / 5704 / 818 / 14
temperature no. 44: 3.937372e-05, energy 4.100126e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
796 / 4953 / 5651 / 752 / 29
temperature no. 45: 3.281143e-05, energy 4.079956e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
771 / 4750 / 5879 / 768 / 17
temperature no. 46: 2.734286e-05, energy 3.995012e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
806 / 4870 / 5724 / 866 / 66
temperature no. 47: 2.278572e-05, energy 3.942081e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
692 / 4993 / 5715 / 875 / 33
temperature no. 48: 1.898810e-05, energy 3.891263e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
812 / 4836 / 5752 / 812 / 39
temperature no. 49: 1.582341e-05, energy 3.836640e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
803 / 4878 / 5719 / 840 / 64
temperature no. 50: 1.318618e-05, energy 3.841673e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
676 / 5100 / 5624 / 853 / 16
temperature no. 51: 1.098848e-05, energy 3.817765e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
606 / 4989 / 5805 / 988 / 17
temperature no. 52: 9.157068e-06, energy 3.812906e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
503 / 5196 / 5701 / 867 / 3
temperature no. 53: 7.630890e-06, energy 3.805340e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
523 / 5162 / 5715 / 879 / 31
temperature no. 54: 6.359075e-06, energy 3.781201e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
494 / 5026 / 5880 / 925 / 69
temperature no. 55: 5.299229e-06, energy 3.764583e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
588 / 5119 / 5693 / 893 / 58
temperature no. 56: 4.416024e-06, energy 3.756299e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
545 / 5095 / 5760 / 923 / 39

```
temperature no. 57: 3.680020e-06, energy 3.738894e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
446 / 5307 / 5647 / 973 / 93
temperature no. 58: 3.066684e-06, energy 3.724358e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
469 / 5128 / 5803 / 908 / 56
temperature no. 59: 2.555570e-06, energy 3.714096e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
476 / 5237 / 5687 / 1042 / 54
temperature no. 60: 2.129641e-06, energy 3.696404e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
466 / 5148 / 5786 / 966 / 121
temperature no. 61: 1.774701e-06, energy 3.688544e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
467 / 5190 / 5743 / 976 / 71
temperature no. 62: 1.478918e-06, energy 3.676124e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
419 / 5272 / 5709 / 1032 / 114
temperature no. 63: 1.232431e-06, energy 3.667500e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
470 / 5171 / 5759 / 1019 / 106
temperature no. 64: 1.027026e-06, energy 3.660298e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
476 / 5097 / 5827 / 1013 / 92
temperature no. 65: 8.558551e-07, energy 3.658330e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
476 / 5232 / 5692 / 1069 / 39
temperature no. 66: 7.132126e-07, energy 3.654768e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
455 / 5188 / 5757 / 1035 / 62
temperature no. 67: 5.943438e-07, energy 3.652897e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
466 / 5145 / 5789 / 1057 / 64
temperature no. 68: 4.952865e-07, energy 3.650679e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
476 / 5141 / 5783 / 1002 / 65
temperature no. 69: 4.127388e-07, energy 3.648444e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
542 / 5107 / 5751 / 1098 / 77
temperature no. 70: 3.439490e-07, energy 3.645968e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
581 / 5069 / 5750 / 1030 / 96
temperature no. 71: 2.866241e-07, energy 3.645081e-02,
```

```
tries with energy less / not less but accepted / rejected: / to far / new
optimum
499 / 5259 / 5642 / 969 / 50
temperature no. 72: 2.388535e-07, energy 3.643385e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
510 / 5077 / 5813 / 1009 / 81
temperature no. 73: 1.990445e-07, energy 3.642956e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
543 / 5141 / 5716 / 1043 / 51
temperature no. 74: 1.658705e-07, energy 3.642123e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
464 / 5293 / 5643 / 999 / 108
temperature no. 75: 1.382254e-07, energy 3.641274e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
475 / 5165 / 5760 / 1060 / 105
temperature no. 76: 1.151878e-07, energy 3.640044e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
439 / 5254 / 5707 / 1073 / 146
temperature no. 77: 9.598985e-08, energy 3.639577e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
444 / 5208 / 5748 / 1057 / 66
temperature no. 78: 7.999154e-08, energy 3.639116e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
498 / 5042 / 5860 / 1130 / 90
temperature no. 79: 6.665962e-08, energy 3.638828e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
562 / 5154 / 5684 / 1033 / 84
temperature no. 80: 5.554968e-08, energy 3.638613e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
491 / 5159 / 5750 / 1055 / 73
temperature no. 81: 4.629140e-08, energy 3.638482e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
556 / 5079 / 5765 / 1036 / 60
temperature no. 82: 3.857617e-08, energy 3.638332e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
549 / 5048 / 5803 / 1071 / 66
temperature no. 83: 3.214681e-08, energy 3.638172e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
505 / 5223 / 5672 / 1099 / 61
temperature no. 84: 2.678900e-08, energy 3.638022e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
523 / 5126 / 5751 / 1086 / 101
temperature no. 85: 2.232417e-08, energy 3.637952e-02,
tries with energy less / not less but accepted / rejected: / to far / new
```

```
optimum
591 / 5067 / 5742 / 1053 / 68
temperature no. 86: 1.860348e-08, energy 3.637882e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
495 / 5099 / 5806 / 1044 / 66
temperature no. 87: 1.550290e-08, energy 3.637813e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
522 / 5133 / 5745 / 1101 / 67
temperature no. 88: 1.291908e-08, energy 3.637764e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
485 / 5144 / 5771 / 1020 / 54
temperature no. 89: 1.076590e-08, energy 3.637695e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
529 / 5160 / 5711 / 1016 / 97
temperature no. 90: 8.971583e-09, energy 3.637630e-02,
tries with energy less / not less but accepted / rejected: / to far / new
optimum
464 / 5183 / 5753 / 1090 / 113
samin: convergence near bounds
objective function: 3.637628e-02
parameter #1, value: 2.390240e-06, search width: 2.882713e-06
parameter #2, value: 1.200443e+00, search width: 2.244508e-05
parameter #3, value: 4.839292e-06, search width: 7.101763e-06
parameter #4, value: 3.838325e-08, search width: 4.670784e-06
parameter #5, value: 2.395126e+00, search width: 6.312678e-06
parameter #6, value: 6.291844e-07, search width: 9.975590e-06
parameter #7, value: 1.113718e-05, search width: 1.893803e-05
parameter #8, value: 5.003287e-06, search width: 1.079798e-05
parameter #9, value: 3.331518e-01, search width: 1.576390e-05
parameter #10, value: 1.297500e-05, search width: 4.044676e-05
parameter #11, value: 2.631951e-05, search width: 9.469017e-06
parameter #12, value: 1.408489e+00, search width: 4.734509e-06
parameter #13, value: 7.689564e-06, search width: 5.119043e-05
parameter #14, value: 4.271186e-05, search width: 4.729169e-05
parameter #15, value: 1.064093e+00, search width: 5.535744e-06
parameter #16, value: 1.468080e+00, search width: 1.995118e-05
parameter #17, value: 4.590806e-05, search width: 5.188883e-05
parameter #18, value: 1.782725e-06, search width: 1.065264e-05
parameter #19, value: 1.334204e+00, search width: 9.331032e-05
parameter #20, value: 1.970785e+00, search width: 1.773438e-05
parameter #21, value: 9.807120e-01, search width: 1.011169e-05
parameter #22, value: 1.729248e+00, search width: 4.987795e-06
parameter #23, value: 7.221944e-01, search width: 3.990236e-05
parameter #24, value: 2.261708e-06, search width: 2.244508e-05
parameter #25, value: 2.266461e+00, search width: 7.006176e-06
parameter #26, value: 1.401956e+00, search width: 1.166379e-05
parameter #27, value: 5.346549e-06, search width: 2.275130e-05
parameter #28, value: 1.742232e+00, search width: 4.044676e-05
parameter #29, value: 2.776983e-05, search width: 2.525071e-05
parameter #30, value: 2.135692e+00, search width: 1.122254e-05
parameter #31, value: 1.540493e+00, search width: 2.559521e-05
parameter #32, value: 3.141590e+00, search width: 1.822159e-05
parameter #33, value: 8.398130e-01, search width: 2.660157e-05
```

```
parameter #34, value: 7.829483e-01, search width: 1.706348e-05
parameter #35, value: 1.101469e-04, search width: 5.758923e-05
parameter #36, value: 1.986346e+00, search width: 1.773438e-05
parameter #37, value: 1.666965e+00, search width: 5.320315e-05
parameter #38, value: 3.141586e+00, search width: 1.420353e-05
parameter #39, value: 1.586089e+00, search width: 9.458337e-05
parameter #40, value: 1.231814e+00, search width: 4.203705e-05
parameter #41, value: 1.334575e+00, search width: 5.050143e-05
parameter #42, value: 2.234657e+00, search width: 1.122254e-05
parameter #43, value: 3.141590e+00, search width: 3.644319e-05
parameter #44, value: 1.663033e-05, search width: 8.199717e-05
parameter #45, value: 1.614768e+00, search width: 5.248705e-05
parameter #46, value: 1.859013e+00, search width: 6.642893e-05
parameter #47, value: 1.717265e+00, search width: 2.396845e-05
parameter #48, value: 1.913216e+00, search width: 1.576390e-05
parameter #49, value: 3.677751e-05, search width: 2.733239e-05
parameter #50, value: 3.141576e+00, search width: 3.113330e-04
parameter #51, value: 1.411070e+00, search width: 1.893803e-05
parameter #52, value: 1.515544e+00, search width: 4.982169e-05
parameter #53, value: 2.145293e+00, search width: 5.050143e-05
parameter #54, value: 1.616647e+00, search width: 3.152779e-05
parameter #55, value: 3.141503e+00, search width: 1.438107e-04
parameter #56, value: 1.881049e+00, search width: 2.101853e-05
parameter #57, value: 3.141554e+00, search width: 3.152779e-05
parameter #58, value: 1.743448e+00, search width: 7.190535e-05
parameter #59, value: 2.446923e+00, search width: 2.992677e-05
parameter #60, value: 1.220025e+00, search width: 4.489016e-05
parameter #61, value: 1.417168e+00, search width: 2.802470e-05
parameter #62, value: 1.295152e+00, search width: 4.261058e-05
parameter #63, value: 3.141576e+00, search width: 1.078580e-04
parameter #64, value: 1.663761e+00, search width: 2.128126e-04
parameter #65, value: 1.388812e+00, search width: 5.758923e-05
parameter #66, value: 3.141580e+00, search width: 1.597897e-05
parameter #67, value: 3.141558e+00, search width: 2.696451e-05
parameter #68, value: 1.982103e+00, search width: 6.642893e-05
parameter #69, value: 2.323653e+00, search width: 3.033507e-05
parameter #70, value: 1.906879e+00, search width: 9.964339e-05
parameter #71, value: 1.774560e+00, search width: 5.392901e-05
parameter #72, value: 3.141592e+00, search width: 2.802470e-05
parameter #73, value: 1.820751e+00, search width: 2.952397e-05
parameter #74, value: 3.141579e+00, search width: 2.022338e-05
parameter #75, value: 3.141563e+00, search width: 1.995118e-05
parameter #76, value: 2.359466e+00, search width: 1.773438e-05
parameter #77, value: 2.498023e+00, search width: 3.195793e-05
parameter #78, value: 3.141551e+00, search width: 3.546876e-05
parameter #79, value: 1.893418e+00, search width: 4.044676e-05
parameter #80, value: 3.141586e+00, search width: 1.496339e-05
parameter #81, value: 2.308693e+00, search width: 3.366762e-05
parameter #82, value: 1.778690e+00, search width: 3.195793e-05
parameter #83, value: 1.833514e+00, search width: 3.321446e-05
parameter #84, value: 3.141557e+00, search width: 6.478789e-05
parameter #85, value: 1.932283e+00, search width: 3.412695e-05
parameter #86, value: 2.217423e+00, search width: 4.793690e-05
parameter #87, value: 1.817266e+00, search width: 6.067014e-05
parameter #88, value: 3.141556e+00, search width: 2.992677e-05
parameter #89, value: 3.141592e+00, search width: 8.303616e-06
parameter #90, value: 1.977918e+00, search width: 2.244508e-05
```

```
parameter #91, value: 2.708890e+00, search width: 4.261058e-05
parameter #92, value: 1.965869e+00, search width: 1.820104e-04
parameter #93, value: 2.131379e+00, search width: 9.458337e-05
parameter #94, value: 2.482933e+00, search width: 2.696451e-05
parameter #95, value: 3.141583e+00, search width: 1.619697e-05
parameter #96, value: 2.095856e+00, search width: 5.248705e-05
parameter #97, value: 3.141580e+00, search width: 2.022338e-05
parameter #98, value: 1.909899e+00, search width: 2.840705e-05
parameter #99, value: 2.208189e+00, search width: 4.428595e-05
parameter #100, value: 2.180619e+00, search width: 2.332758e-05
parameter #101, value: 2.037188e+00, search width: 4.982169e-05
parameter #102, value: 3.141576e+00, search width: 5.758923e-05
parameter #103, value: 3.141567e+00, search width: 5.320315e-05
parameter #104, value: 3.141583e+00, search width: 6.305558e-05
parameter #105, value: 2.665187e+00, search width: 5.985354e-05
parameter #106, value: 2.200263e+00, search width: 2.660157e-05
parameter #107, value: 2.311863e+00, search width: 2.696451e-05
parameter #108, value: 2.053660e+00, search width: 1.749568e-05
parameter #109, value: 3.141591e+00, search width: 6.642893e-05
parameter #110, value: 2.337870e+00, search width: 3.321446e-05
parameter #111, value: 2.634057e+00, search width: 2.992677e-05
parameter #112, value: 2.375180e+00, search width: 3.195793e-05
parameter #113, value: 2.329185e+00, search width: 4.428595e-05
parameter #114, value: 2.540363e+00, search width: 3.152779e-05
cvg =  1
objf =  0.036376
```

In [12]:
```
format long
```

In [18]:
```
save "VA3ASE_A_s.mat" VA3ASE_A_s
```

In [19]:
```
save "VA3ASE_Phi_d.mat" VA3ASE_Phi_d
```

In [ ]:
```

```