```
Exit[];
```

```
c = {1 - 3 n^2 x^2 + 2 n^3 x^3, 3 n^2 x^2 - 2 n^3 x^3, x - 2 n x^2 + n^2 x^3, -n x^2 + n^2 x^3}
```

$$\{1 - 3 n^2 x^2 + 2 n^3 x^3,\ 3 n^2 x^2 - 2 n^3 x^3,\ x - 2 n x^2 + n^2 x^3,\ -n x^2 + n^2 x^3\}$$

```
b = 1 / n;
```

```
Y[i_, h_] := {y[i], y[i + 1], m[i], m[i + 1]}.c /. x → h;
{Y[i, 0], Y[i, 1 / n], D[Y[i, x], x] /. x → 0, D[Y[i, x], x] /. x → 1 / n}
```

$$\{y[i],\ y[1 + i],\ m[i],\ m[1 + i]\}$$

```
Simplify[(D[Y[1, x], {x, 2}] / 4 / n /. x → 0) == 0]
```

$$2\, m[1] + m[2] + 3\, n\, y[1] == 3\, n\, y[2]$$

```
Simplify[(D[Y[n, x], {x, 2}] / 4 / n /. x → b) == 0]
```

$$m[n] + 2\, m[1 + n] + 3\, n\, y[n] == 3\, n\, y[1 + n]$$

```
Simplify[(D[Y[i, x], {x, 2}] / 4 / n /. x → b) == (D[Y[i + 1, x], {x, 2}] / 4 / n /. x → 0)]
```

$$m[i] + 4\, m[1 + i] + m[2 + i] + 3\, n\, y[i] == 3\, n\, y[2 + i]$$

```
M[n_] := SparseArray[{{1, 1} → -2, (n + 1) {1, 1} → 2,
    {n + 1, n} → -2, {1, 2} → 2, {i_, j_} /; (i == j + 1 && i < n + 1 && i > 1) → -1,
    {i_, j_} /; (i == j - 1 && i < n + 1 && i > 1) → 1}, (n + 1) {1, 1}];
M[5] // MatrixForm
```

$$\begin{pmatrix} -2 & 2 & 0 & 0 & 0 & 0 \\ -1 & 0 & 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 1 & 0 & 0 \\ 0 & 0 & -1 & 0 & 1 & 0 \\ 0 & 0 & 0 & -1 & 0 & 1 \\ 0 & 0 & 0 & 0 & -2 & 2 \end{pmatrix}$$

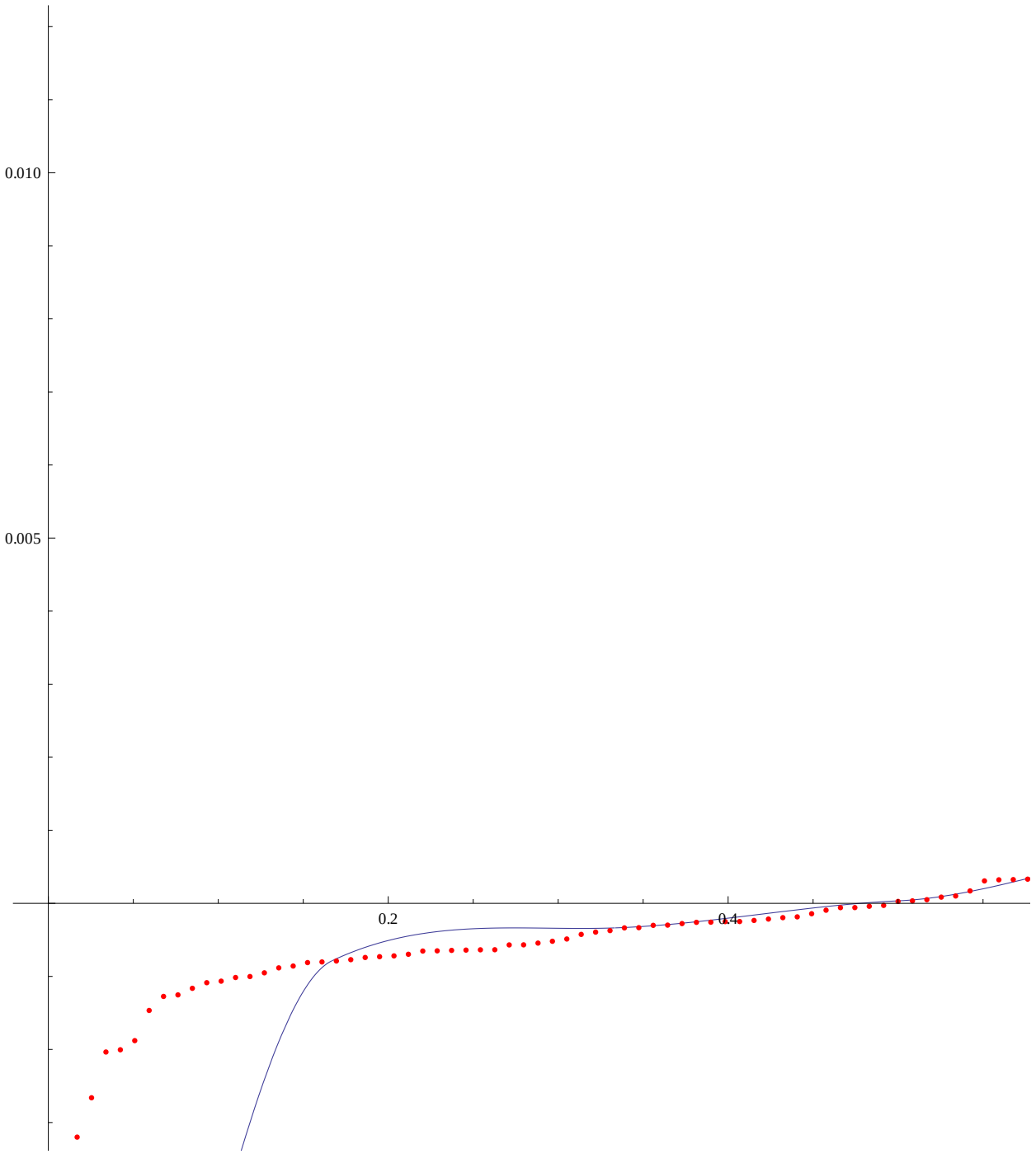
los:

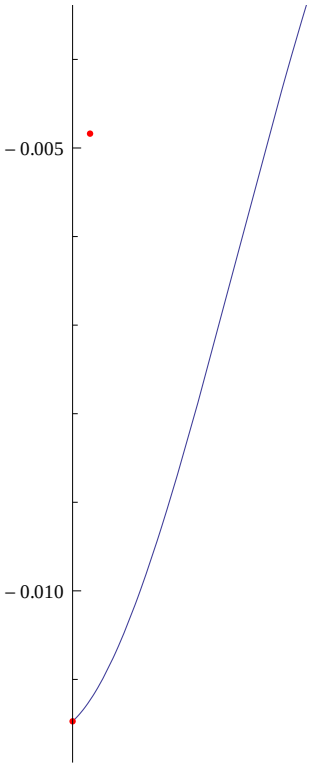
```
y = Transpose[XY][[2]]; y = Table[y[[i]], {i, 1, Length[y], 20}];
If[y[[Length[y]]] ≠ XY[[Length[XY], 2]], AppendTo[y, XY[[Length[XY], 2]]]];
n = Length[y] - 1; m = M[n].y;
```

```
For[i = 1, i ≤ n, i++,
  delta = (y[[i + 1]] - y[[i]]) n;
  If[delta == 0, m[[i]] = 0; m[[i + 1]] = 0,
   a = m[[i]] / delta; b = m[[i + 1]] / delta;
   If[a^2 + b^2 > 3,
    t = 3 / Sqrt[a^2 + b^2]; m[[i]] = t a delta; m[[i + 1]] = t b delta;]
  ]];
```

```
Y[x0_] := Module[{i, x = x0, y = y, m = m, c = c, n = n},
  i = Ceiling[x * n];
  x -= (i - 1) / n;
  {y[[i]], y[[i + 1]], m[[i]], m[[i + 1]]}.
   {1 - 3 n^2 x^2 + 2 n^3 x^3, 3 n^2 x^2 - 2 n^3 x^3, x - 2 n x^2 + n^2 x^3, -n x^2 + n^2 x^3}
 ]
```

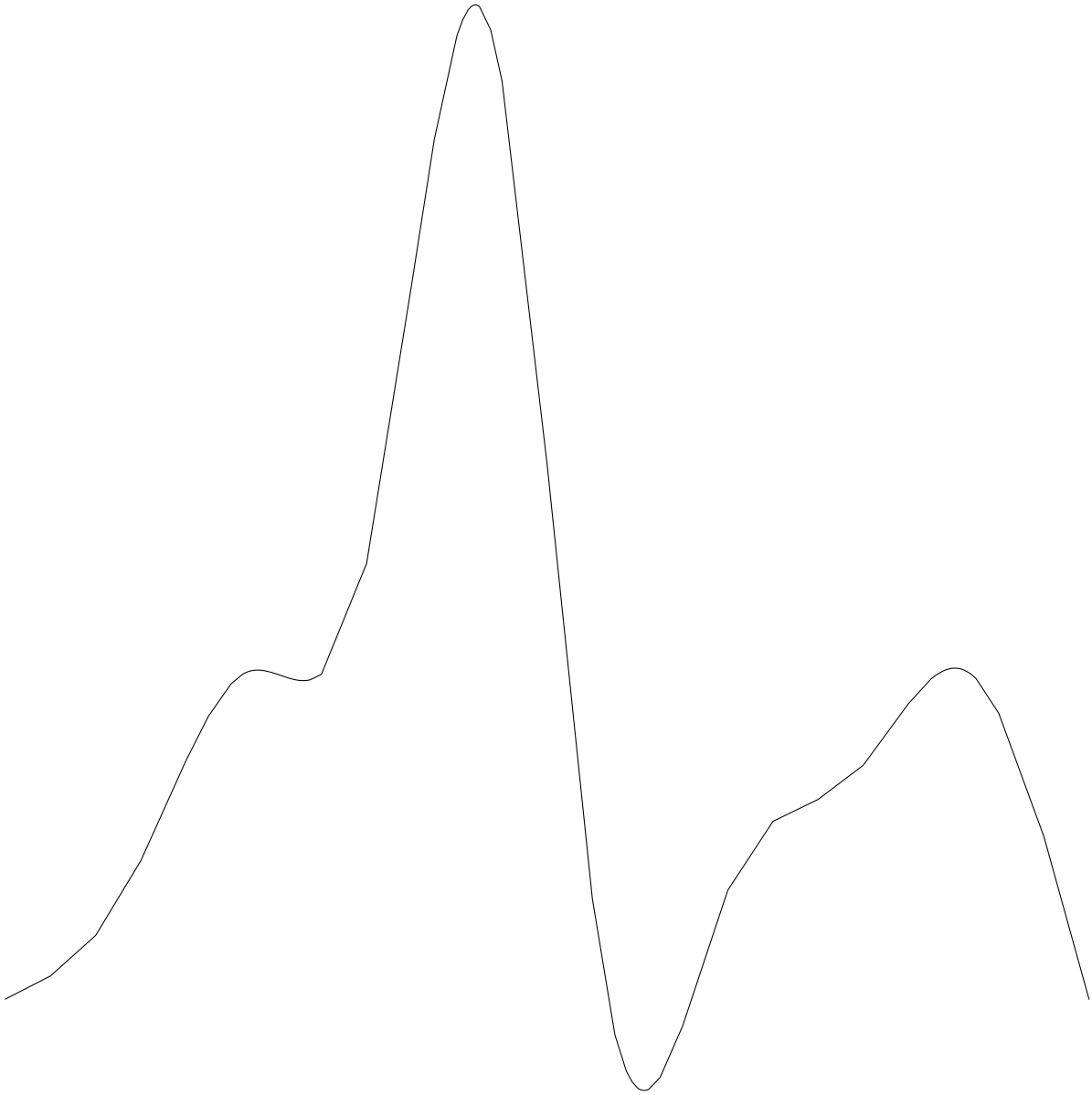
```
Show[Plot[Y[x], {x, 0, 1}, AspectRatio → 1, PlotRange → All],
 ListPlot[XY, PlotStyle → Red]]
```






```
<< Splines`
```

```
Graphics[Spline[Table[{i / (Length[y] - 1), y[[i + 1]]}, {i, 0, Length[y] - 1}], Cubic],
 AspectRatio → 1]
```



```
Y[x0_] := Module[{i = n, x = x0, p = y, m = m, n = n, b, y},
  If[x == 0, i = 1,
   While[x ≤ (i - 1) / n, i--];];
  b = 1 / n;
  {p[[i]], p[[i + 1]], m[[i, 1]], m[[i, 2]], m[[n + i, 1]], m[[n + i, 2]]}.
    {1 - 10 y^3/b^3 + 15 y^4/b^4 - 6 y^5/b^5, 10 y^3/b^3 - 15 y^4/b^4 + 6 y^5/b^5, y - 6 y^3/b^2 + 8 y^4/b^3 - 3 y^5/b^4,
     -4 y^3/b^2 + 7 y^4/b^3 - 3 y^5/b^4, y^2/2 - 3 y^3/(2 b) + 3 y^4/(2 b^2) - y^5/(2 b^3), y^3/(2 b) - y^4/b^2 + y^5/(2 b^3)} /. y → (x - (i - 1) / n)
 ]

y = {XY[[1, 2]], XY[[Length[XY], 2]]}; y = Transpose[XY][[2]];
y = Table[y[[i]], {i, 1, Length[y], 2}];
If[y[[Length[y]]] ≠ XY[[Length[XY], 2]], AppendTo[y, XY[[Length[XY], 2]]]];

n = Length[y] - 1;

n
```

6

```
m = Table[ts[i, j], {i, 2 n}, {j, 2}];

d = (Y[#[[1]]] - #[[2]])^2 & /@ XY; d = Sum[d[[i]], {i, Length[d]}];
g = Solve[Flatten[Table[D[d, ts[i, j]] == 0, {i, 2 n}, {j, 2}]], Flatten[m]][[1]]
```

```
{ts[1, 1] → 1.0823, ts[1, 2] → -3.6435 × 10^-6, ts[2, 1] → -0.0151759,
 ts[2, 2] → 2.77363 × 10^-7, ts[3, 1] → -0.0113918, ts[3, 2] → 2.8026 × 10^-6,
 ts[4, 1] → 0.0193723, ts[4, 2] → 0., ts[5, 1] → -0.0000660752, ts[5, 2] → 0.571534,
 ts[6, 1] → -8.38091 × 10^-7, ts[6, 2] → -0.00384619, ts[7, 1] → 1.11775 × 10^-6,
 ts[7, 2] → 1.0304 × 10^-6, ts[8, 1] → 0.00643999, ts[8, 2] → -1.97915 × 10^-6,
 ts[9, 1] → -0.0406935, ts[9, 2] → 1.06037 × 10^-6, ts[10, 1] → -0.0002147,
 ts[10, 2] → 0.000164586, ts[11, 1] → 3.53879 × 10^-7, ts[11, 2] → 0.000792036,
 ts[12, 1] → -2.59419 × 10^-11, ts[12, 2] → 5.14753 × 10^-7, ts[13, 1] → 4.53752 × 10^-7,
 ts[13, 2] → 0.0163343, ts[14, 1] → -8.31444 × 10^-9, ts[14, 2] → -1.03083 × 10^-7,
 ts[15, 1] → 7.14926 × 10^-9, ts[15, 2] → -7.28265 × 10^-12, ts[16, 1] → -0.00837183,
 ts[16, 2] → -4.2512 × 10^-6, ts[17, 1] → -0.00985838, ts[17, 2] → -0.00375587,
 ts[18, 1] → 1.29474 × 10^-7, ts[18, 2] → 0.00153424, ts[19, 1] → -3.59751 × 10^-7,
 ts[19, 2] → -0.00155962, ts[20, 1] → 2.53477 × 10^-8, ts[20, 2] → -3.25012 × 10^-8,
 ts[21, 1] → -0.00814505, ts[21, 2] → 1.77568 × 10^-8, ts[22, 1] → 0.000612166,
 ts[22, 2] → -3.55903 × 10^-7, ts[23, 1] → 0.144097, ts[23, 2] → 0.137109,
 ts[24, 1] → -6.39497 × 10^-7, ts[24, 2] → -0.00327646, ts[25, 1] → 2.66831 × 10^-7,
 ts[25, 2] → 9.11875 × 10^-6, ts[26, 1] → -1.43491 × 10^-7, ts[26, 2] → 0.00194979,
 ts[27, 1] → 5.22883 × 10^-10, ts[27, 2] → -3.14415 × 10^-8, ts[28, 1] → -0.00253188,
 ts[28, 2] → 7.16435 × 10^-7, ts[29, 1] → 0.000761042, ts[29, 2] → 9.29119 × 10^-8,
 ts[30, 1] → 0.00727979, ts[30, 2] → 0.000626354, ts[31, 1] → 2.94519 × 10^-7,
 ts[31, 2] → -0.00319948, ts[32, 1] → -2.33249 × 10^-7, ts[32, 2] → 0.00946658,
 ts[33, 1] → -1.37021 × 10^-7, ts[33, 2] → 1.83269 × 10^-7, ts[34, 1] → -0.000435513,
 ts[34, 2] → -6.99444 × 10^-9, ts[35, 1] → 0.000559624, ts[35, 2] → 1.99426 × 10^-7,
```

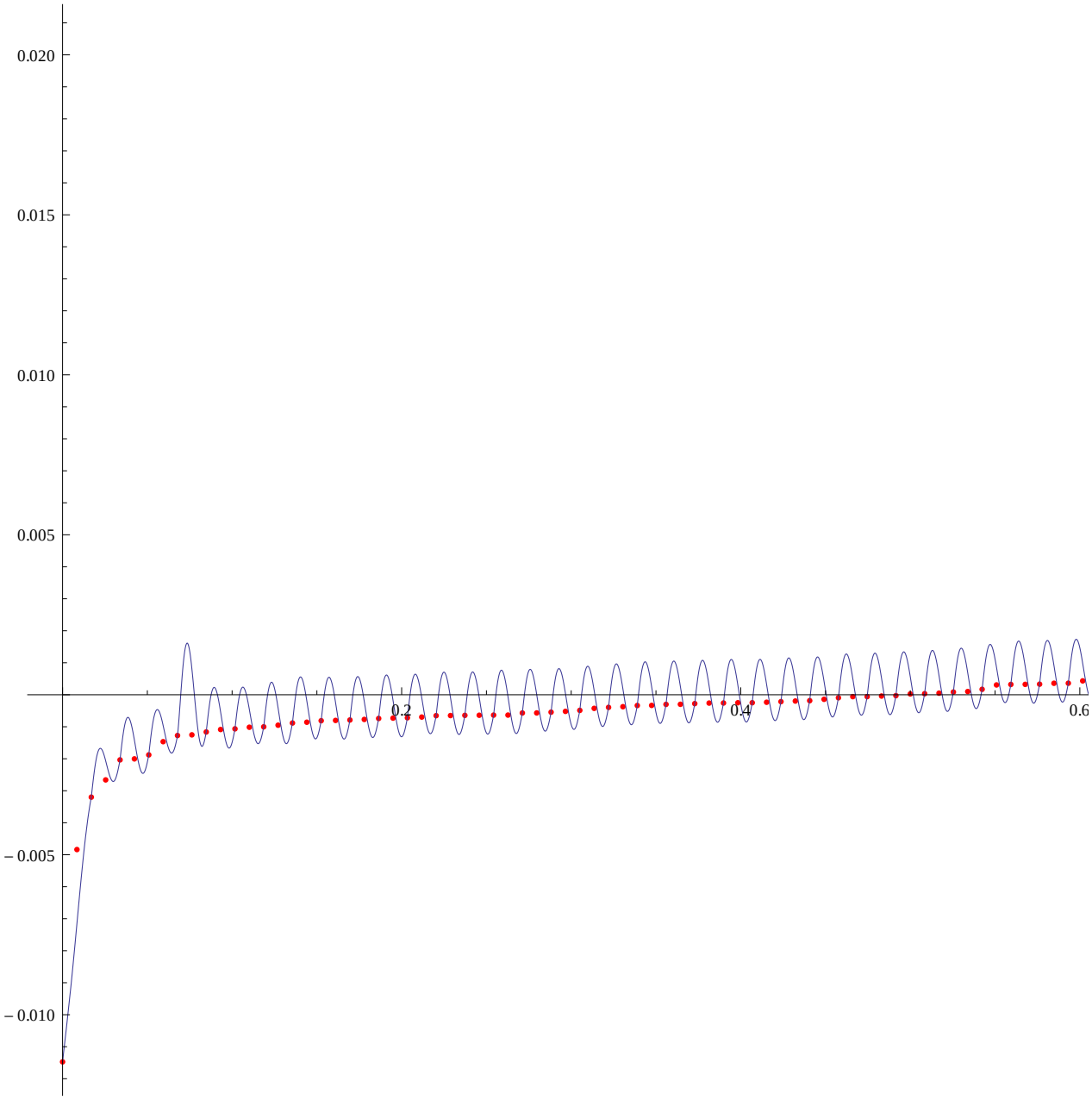
$$\begin{aligned}
&ts[36,\,1] \to 0.00297729,\ ts[36,\,2] \to 5.79113\times10^{-7},\ ts[37,\,1] \to -0.00305266,\\
&ts[37,\,2] \to -0.00609373,\ ts[38,\,1] \to 5.1309\times10^{-7},\ ts[38,\,2] \to 0.00871657,\\
&ts[39,\,1] \to 2.00965\times10^{-8},\ ts[39,\,2] \to -0.000350942,\ ts[40,\,1] \to -1.82019\times10^{-8},\\
&ts[40,\,2] \to 1.45694\times10^{-8},\ ts[41,\,1] \to 0.000723568,\ ts[41,\,2] \to 4.64264\times10^{-8},\\
&ts[42,\,1] \to -2.39426\times10^{-7},\ ts[42,\,2] \to -4.05992\times10^{-11},\ ts[43,\,1] \to -0.00494753,\\
&ts[43,\,2] \to -0.00506425,\ ts[44,\,1] \to 1.46797\times10^{-7},\ ts[44,\,2] \to -0.00465825,\\
&ts[45,\,1] \to -8.14146\times10^{-8},\ ts[45,\,2] \to -0.00227377,\ ts[46,\,1] \to 7.18358\times10^{-8},\\
&ts[46,\,2] \to 3.72287\times10^{-9},\ ts[47,\,1] \to 1.37114\times10^{-7},\ ts[47,\,2] \to 8.42229\times10^{-12},\\
&ts[48,\,1] \to 0.0125375,\ ts[48,\,2] \to -6.35024\times10^{-7},\ ts[49,\,1] \to -0.0272504,\\
&ts[49,\,2] \to 4.56494\times10^{-6},\ ts[50,\,1] \to 0.0373004,\ ts[50,\,2] \to 0.0249767,\\
&ts[51,\,1] \to 6.50168\times10^{-6},\ ts[51,\,2] \to -0.071426,\ ts[52,\,1] \to -4.84526\times10^{-7},\\
&ts[52,\,2] \to 0.00557458,\ ts[53,\,1] \to -3.751\times10^{-7},\ ts[53,\,2] \to -2.28261\times10^{-7},\\
&ts[54,\,1] \to 0.010349,\ ts[54,\,2] \to 2.39079\times10^{-7},\ ts[55,\,1] \to -0.00449078,\\
&ts[55,\,2] \to -1.97346\times10^{-7},\ ts[56,\,1] \to 0.000709043,\ ts[56,\,2] \to -0.00386641,\\
&ts[57,\,1] \to 3.52967\times10^{-6},\ ts[57,\,2] \to -0.0270599,\ ts[58,\,1] \to -3.8275\times10^{-7},\\
&ts[58,\,2] \to 0.0196661,\ ts[59,\,1] \to -0.00018142,\ ts[59,\,2] \to 6.67817,\ ts[60,\,1] \to -34.345,\\
&ts[60,\,2] \to -47.6272,\ ts[61,\,1] \to -2.56596,\ ts[61,\,2] \to 1.82046,\ ts[62,\,1] \to -16.,\\
&ts[62,\,2] \to 12.251,\ ts[63,\,1] \to -18.8114,\ ts[63,\,2] \to 32.,\ ts[64,\,1] \to 339.047,\\
&ts[64,\,2] \to -9.50602,\ ts[65,\,1] \to 7.0635,\ ts[65,\,2] \to -3.09377,\ ts[66,\,1] \to -26.3816,\\
&ts[66,\,2] \to 30.5071,\ ts[67,\,1] \to 12.2701,\ ts[67,\,2] \to -17.964,\ ts[68,\,1] \to 15.8686,\\
&ts[68,\,2] \to 5.68961,\ ts[69,\,1] \to 0.084268,\ ts[69,\,2] \to -0.306083,\ ts[70,\,1] \to -1.49157,\\
&ts[70,\,2] \to 0.622097,\ ts[71,\,1] \to 0.000131837,\ ts[71,\,2] \to 0.000309723,\\
&ts[72,\,1] \to -5.35569,\ ts[72,\,2] \to 12.5429,\ ts[73,\,1] \to 1.18473,\ ts[73,\,2] \to -1.51892,\\
&ts[74,\,1] \to -0.0000209261,\ ts[74,\,2] \to -0.0000401053,\ ts[75,\,1] \to 16.9927,\\
&ts[75,\,2] \to -19.296,\ ts[76,\,1] \to 1.0385,\ ts[76,\,2] \to 4.33681\times10^{-19},\\
&ts[77,\,1] \to -0.6367,\ ts[77,\,2] \to 0.873711,\ ts[78,\,1] \to 2.8305,\ ts[78,\,2] \to -0.185246,\\
&ts[79,\,1] \to -0.495827,\ ts[79,\,2] \to -1.28585,\ ts[80,\,1] \to 1.39899,\ ts[80,\,2] \to 0.175671,\\
&ts[81,\,1] \to -0.366519,\ ts[81,\,2] \to -2.,\ ts[82,\,1] \to -0.487093,\ ts[82,\,2] \to -1.96284,\\
&ts[83,\,1] \to 2.60241,\ ts[83,\,2] \to -3.75542,\ ts[84,\,1] \to -1.57432,\ ts[84,\,2] \to 1.13425,\\
&ts[85,\,1] \to 1.53906,\ ts[85,\,2] \to 0.502709,\ ts[86,\,1] \to -0.0296981,\ ts[86,\,2] \to -0.52828,\\
&ts[87,\,1] \to -0.00306103,\ ts[87,\,2] \to 5.28408,\ ts[88,\,1] \to -0.219279,\\
&ts[88,\,2] \to 0.438558,\ ts[89,\,1] \to 1.1985,\ ts[89,\,2] \to 0.,\ ts[90,\,1] \to -1.39025,\\
&ts[90,\,2] \to -2.61385,\ ts[91,\,1] \to 1.72055,\ ts[91,\,2] \to -2.03868,\ ts[92,\,1] \to 2.32895,\\
&ts[92,\,2] \to 11.2633,\ ts[93,\,1] \to -0.00243271,\ ts[93,\,2] \to -0.0748942,\\
&ts[94,\,1] \to 1.38933,\ ts[94,\,2] \to 1.17664,\ ts[95,\,1] \to -0.437468,\ ts[95,\,2] \to 2.3569,\\
&ts[96,\,1] \to -1.7784,\ ts[96,\,2] \to -3.35749,\ ts[97,\,1] \to -2.88359,\ ts[97,\,2] \to 5.46428,\\
&ts[98,\,1] \to -0.197677,\ ts[98,\,2] \to 0.214086,\ ts[99,\,1] \to 0.71371,\ ts[99,\,2] \to 0.28754,\\
&ts[100,\,1] \to -0.346736,\ ts[100,\,2] \to 0.365231,\ ts[101,\,1] \to 0.0000959718,\\
&ts[101,\,2] \to -0.000130176,\ ts[102,\,1] \to -0.205296,\ ts[102,\,2] \to -1.53448,\\
&ts[103,\,1] \to -0.666426,\ ts[103,\,2] \to -0.0768087,\ ts[104,\,1] \to 0.565089,\\
&ts[104,\,2] \to -0.569554,\ ts[105,\,1] \to -1.05936,\ ts[105,\,2] \to -0.499442,\\
&ts[106,\,1] \to -0.0011975,\ ts[106,\,2] \to 0.000174175,\ ts[107,\,1] \to -0.000325132,\\
&ts[107,\,2] \to -3.94381,\ ts[108,\,1] \to 2.52051,\ ts[108,\,2] \to 19.2403,\ ts[109,\,1] \to -10.2788,\\
&ts[109,\,2] \to -6.80745\times10^{-19},\ ts[110,\,1] \to -34.8736,\ ts[110,\,2] \to 4.76171,\\
&ts[111,\,1] \to 4.3992,\ ts[111,\,2] \to 1.56344,\ ts[112,\,1] \to 11.2038,\ ts[112,\,2] \to -5.41162,\\
&ts[113,\,1] \to -4.,\ ts[113,\,2] \to 2.01487,\ ts[114,\,1] \to 0.319386,\ ts[114,\,2] \to -1.01247,\\
&ts[115,\,1] \to -0.6678,\ ts[115,\,2] \to -1.02936,\ ts[116,\,1] \to -15.4272,\ ts[116,\,2] \to -22.929,\\
&ts[117,\,1] \to 2.50975,\ ts[117,\,2] \to 14.2177,\ ts[118,\,1] \to 2380.09,\ ts[118,\,2] \to 493.507\}
\end{aligned}$$

```
m = Table[ts[i, j], {i, 2 n}, {j, 2}] /. g;

m[[1 ;; n]] = n / 2 M[n].y;

m = Table[ts[i, j], {i, n}, {j, 2}] /. g;
For[i = 1, i ≤ n, i++,
 delta = (P[[i + 1, 2]] - P[[i, 2]]) / (P[[i + 1, 1]] - P[[i, 1]]);
 a = m[[i]] / delta; b = m[[i + 1]] / delta;
 If[a^2 + b^2 > 3,
  t = 3 / Sqrt[a^2 + b^2]; m[[i]] = t a delta; m[[i + 1]] = t b delta;]
]; m
```

```
Show[ListPlot[{XY}, PlotRange → All, PlotStyle → Red],
 Plot[Y[x], {x, 0, 1}, PlotRange → All]]
```




```
Solve[Table[D[d, ys[i]] == 0, {i, nN}], Table[ys[i], {i, nN}]]
```

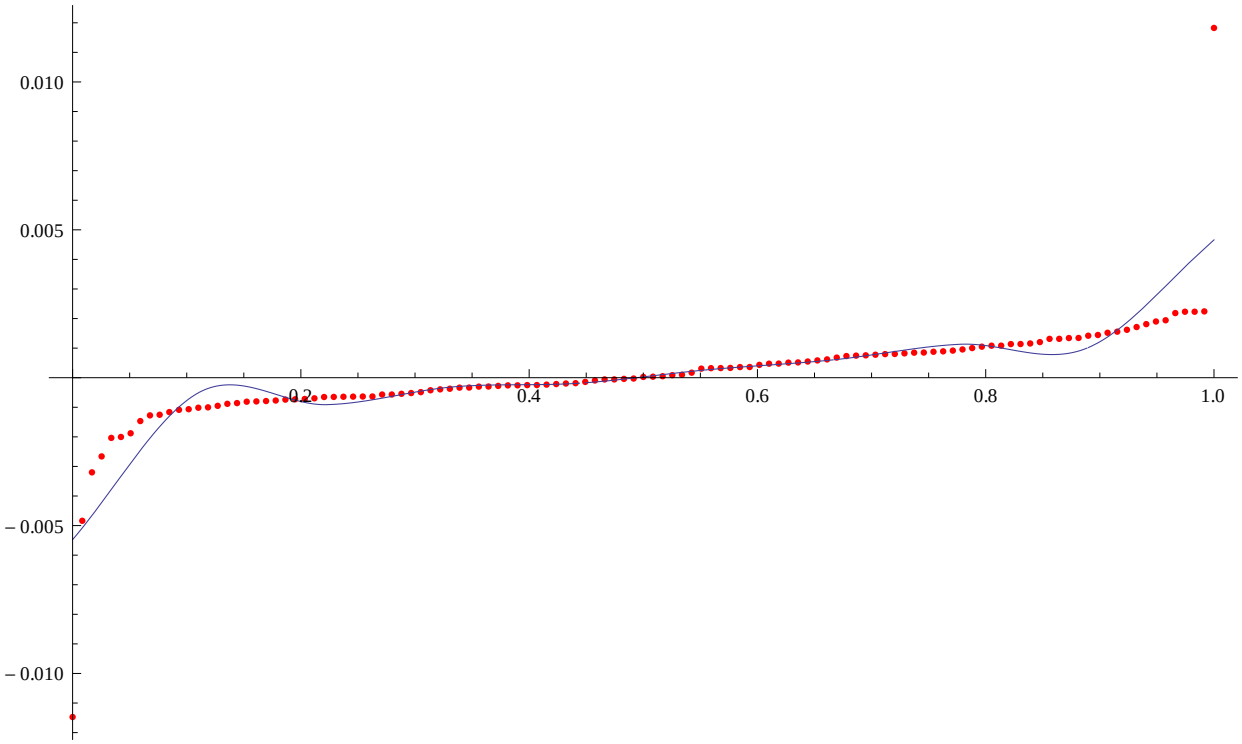
```
{{ys[1] → -0.00547464, ys[2] → -0.000492335, ys[3] → -0.000911088,
  ys[4] → -0.00031071, ys[5] → -0.000185091, ys[6] → 0.000265952,
  ys[7] → 0.00060474, ys[8] → 0.00113058, ys[9] → 0.00100276, ys[10] → 0.0046597}}
```

```
y = Table[ys[i], {i, nN}] /. %[[1]];
```

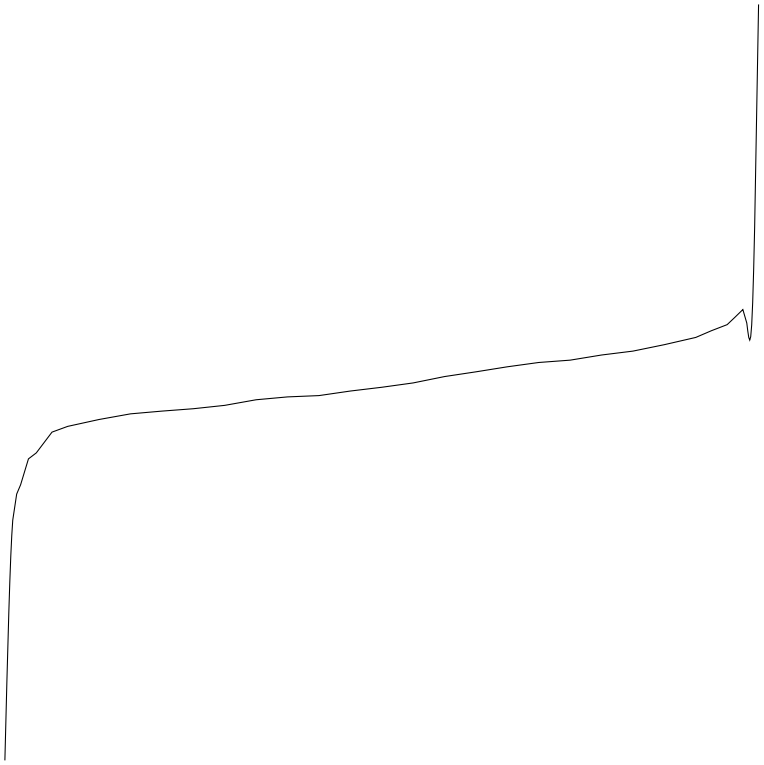
```
nN = 10; y = Table[ys[i], {i, nN}];
```

```
m = n / 2 M[n].y; n = Length[y] - 1;
d = (Y[#[[1]]] - #[[2]])^2 & /@ XY; d = Sum[d[[i]], {i, Length[d]}]
Show[ListPlot[XY, PlotStyle → Red, PlotRange → All],
 Plot[Y[x], {x, 0, 1}, PlotRange → All]]
```

```
0.000118941
```



```
Graphics[Spline[XY, Cubic], AspectRatio → 1]
```



```
Y[0]
```

0.01

```
{#[[1]]} & /@ XY
```

```
{{0.}, {0.008475}, {0.016949}, {0.025424}, {0.033898}, {0.042373}, {0.050847},
 {0.059322}, {0.067797}, {0.076271}, {0.084746}, {0.09322}, {0.101695}, {0.110169},
 {0.118644}, {0.127119}, {0.135593}, {0.144068}, {0.152542}, {0.161017}, {0.169492},
 {0.177966}, {0.186441}, {0.194915}, {0.20339}, {0.211864}, {0.220339}, {0.228814},
 {0.237288}, {0.245763}, {0.254237}, {0.262712}, {0.271186}, {0.279661}, {0.288136},
 {0.29661}, {0.305085}, {0.313559}, {0.322034}, {0.330508}, {0.338983}, {0.347458},
 {0.355932}, {0.364407}, {0.372881}, {0.381356}, {0.389831}, {0.398305}, {0.40678},
 {0.415254}, {0.423729}, {0.432203}, {0.440678}, {0.449153}, {0.457627}, {0.466102},
 {0.474576}, {0.483051}, {0.491525}, {0.5}, {0.508475}, {0.516949}, {0.525424},
 {0.533898}, {0.542373}, {0.550847}, {0.559322}, {0.567797}, {0.576271}, {0.584746},
 {0.59322}, {0.601695}, {0.610169}, {0.618644}, {0.627119}, {0.635593}, {0.644068},
 {0.652542}, {0.661017}, {0.669492}, {0.677966}, {0.686441}, {0.694915}, {0.70339},
 {0.711864}, {0.720339}, {0.728814}, {0.737288}, {0.745763}, {0.754237}, {0.762712},
 {0.771186}, {0.779661}, {0.788136}, {0.79661}, {0.805085}, {0.813559}, {0.822034},
 {0.830508}, {0.838983}, {0.847458}, {0.855932}, {0.864407}, {0.872881}, {0.881356},
 {0.889831}, {0.898305}, {0.90678}, {0.915254}, {0.923729}, {0.932203}, {0.940678},
 {0.949153}, {0.957627}, {0.966102}, {0.974576}, {0.983051}, {0.991525}, {1.}}
```

```
Export["c:\\sdasd.txt", {Round[#[[1]]], #[[2]]} & /@ (XY * (Length[XY] - 1))]
```

```
c:\sdasd.txt
```