

Simulations on the Sphere: Distribution of Points and Calculations of Energy

Annex

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1. Figures

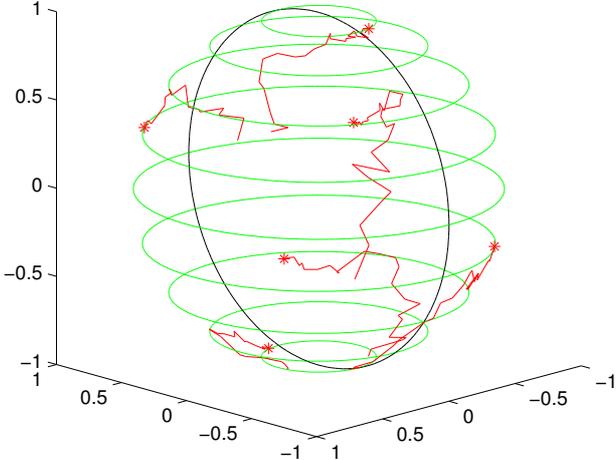


Figure 1: Typical Movements of the points when using the stochastic simulation

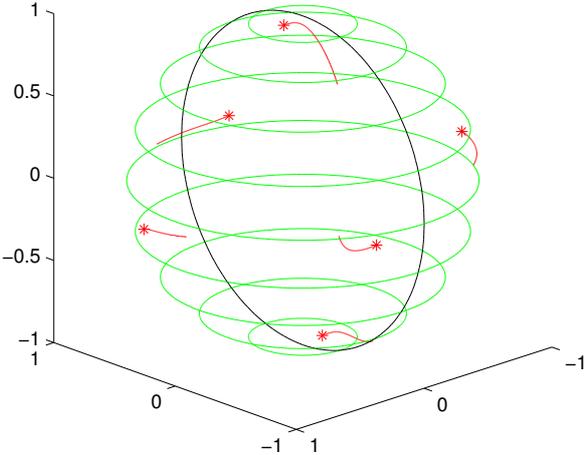


Figure 2: Typical Movements of the points when using the deterministic simulation

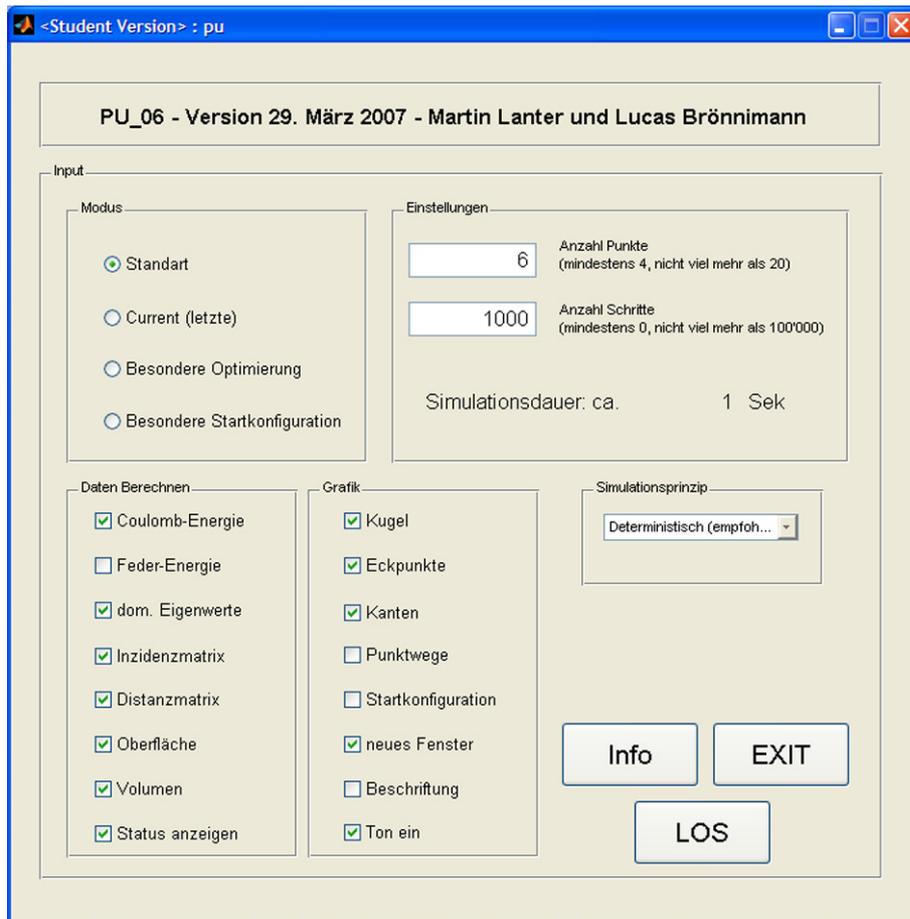


Figure 3: Graphical User Interface (GUI) for easier use of the simulations

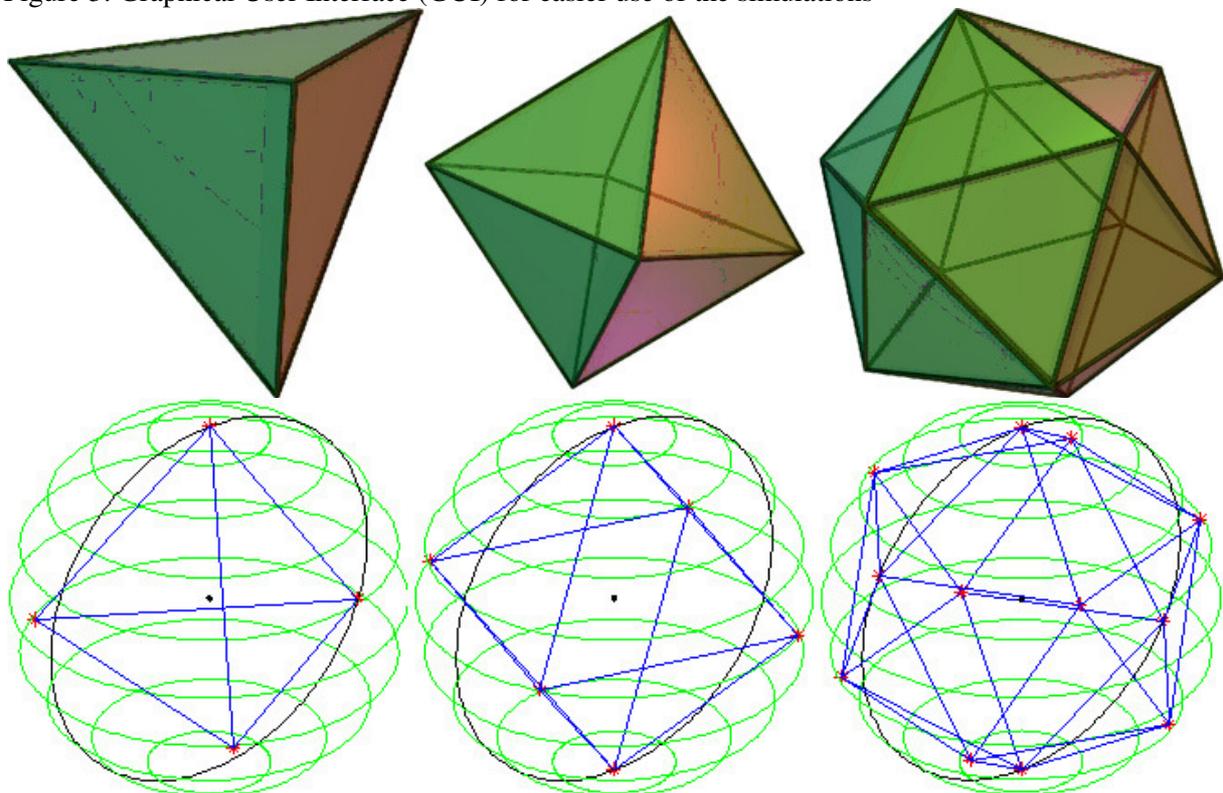


Figure 4: Comparison of the 3 platonic solid composed of triangles

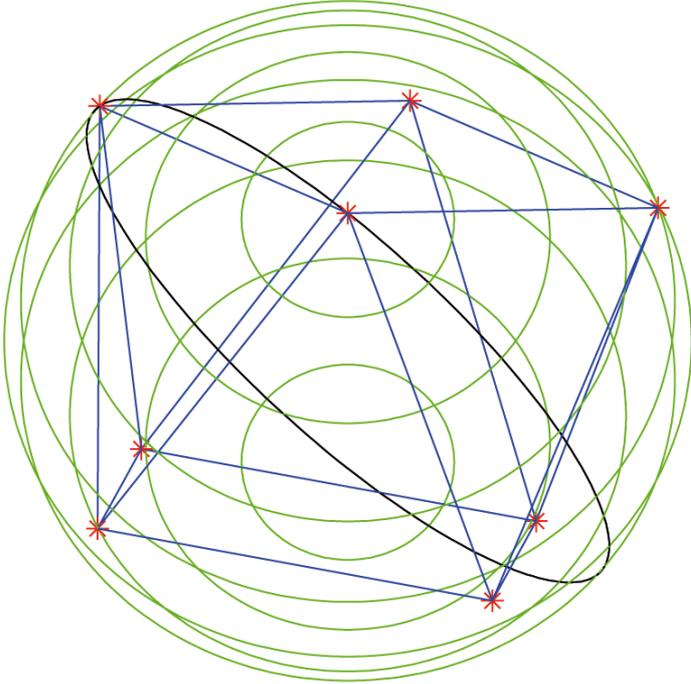


Figure 5: Configuration with maximum property for $n = 8$

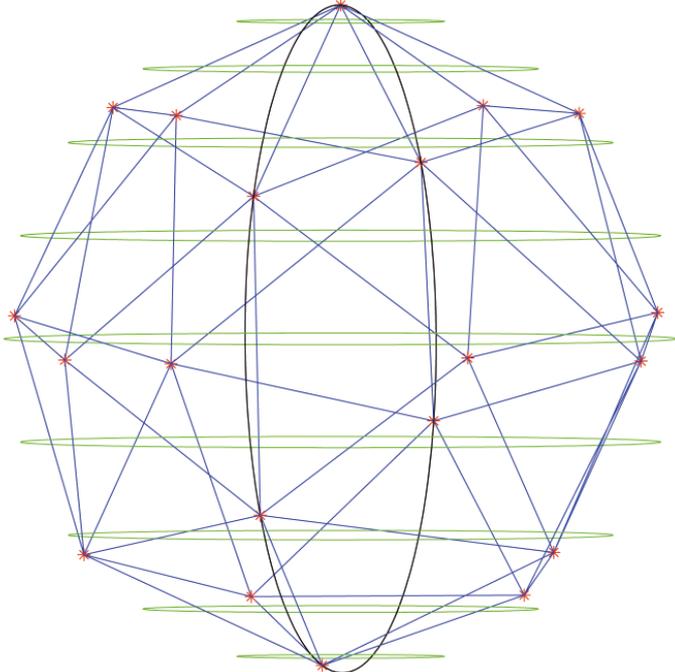


Figure 6: Configuration with maximum property for $n = 20$

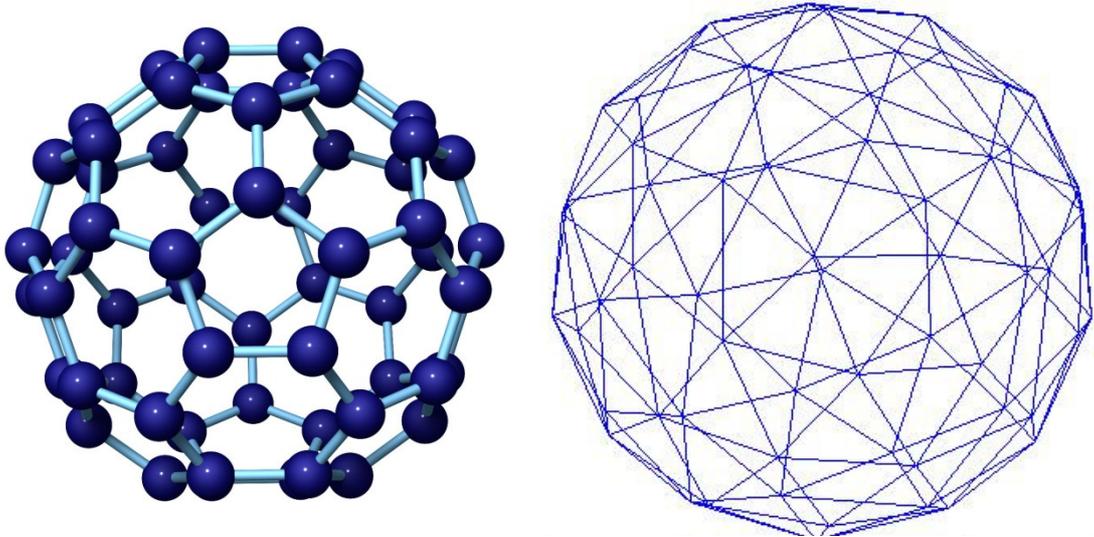


Figure 7: Comparison of the C60 and the solid found by our simulations with $n = 60$

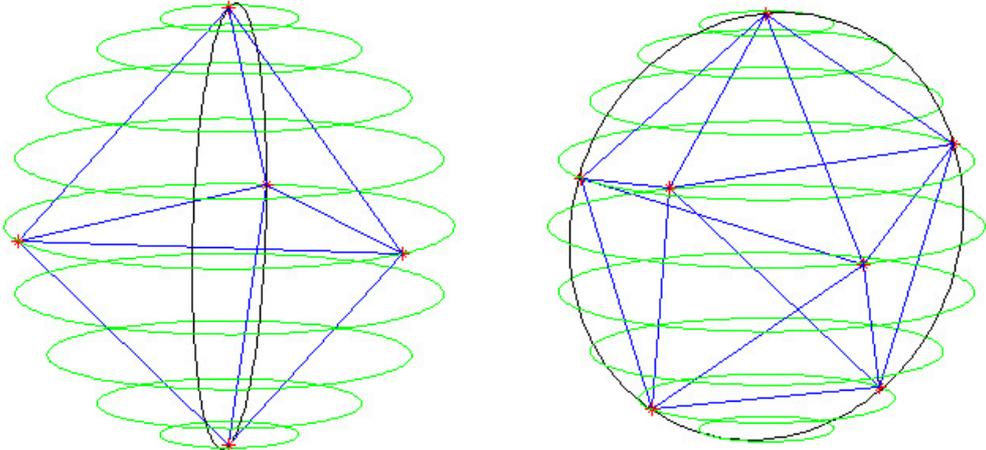


Figure 8: Solids found by our simulations with $n = 5$ and $n = 7$

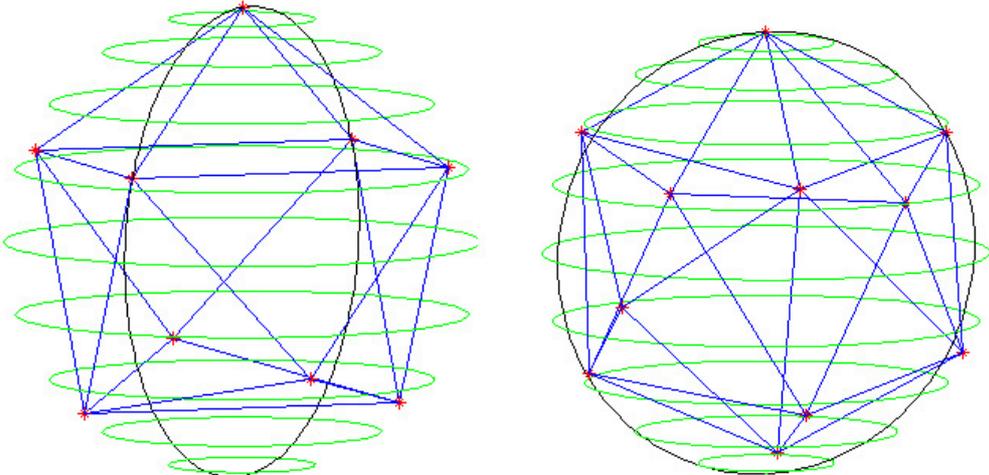


Figure 9: Solids found by our simulations with $n = 9$ and $n = 11$

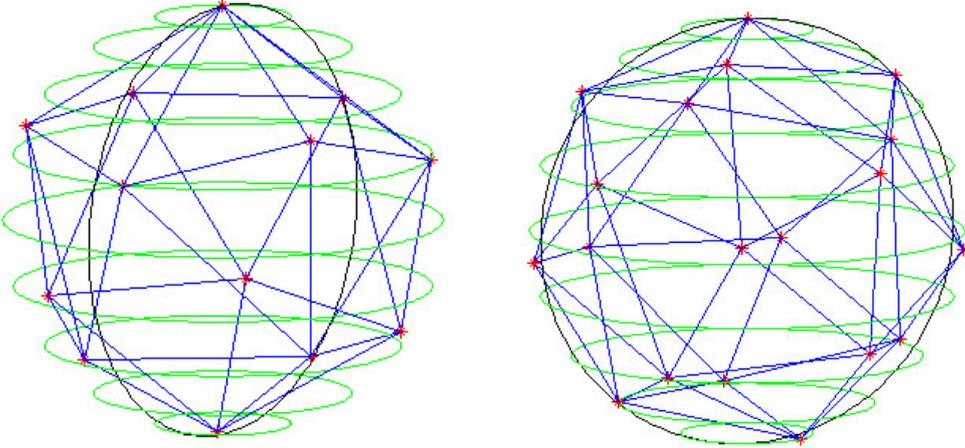


Figure 10: Solids found by our simulations with $n = 13$ and $n = 15$

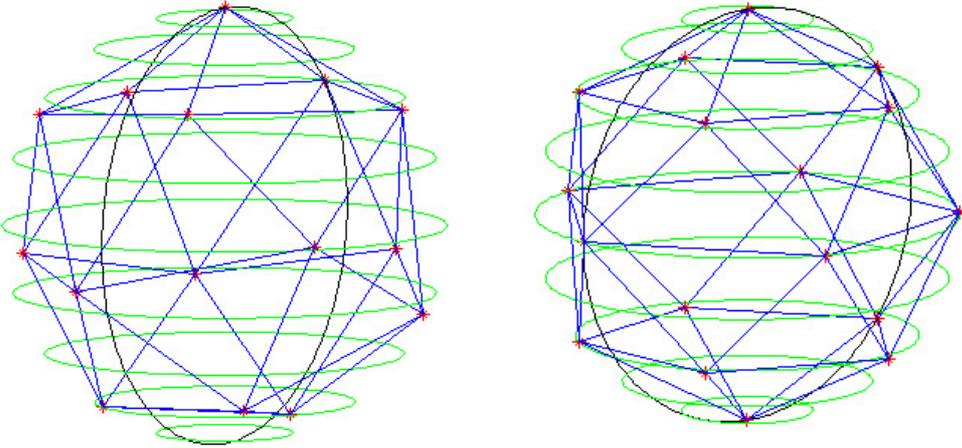


Figure 11: Solids found by our simulations with $n = 17$ and $n = 19$

2. Tables

| Constant | Accuracy | | | | |
|----------|-----------|-----------|-----------|-----------|-----------|
| | 10^{-2} | 10^{-3} | 10^{-4} | 10^{-5} | 10^{-6} |
| K = 1000 | 6 | 8 | 10 | 12 | 15 |
| K = 25 | 7 | 9 | 11 | 13 | 15 |
| K = 5 | 8 | 10 | 13 | 16 | 19 |
| K = 1 | 14 | 19 | 25 | 30 | 35 |
| K = 1/5 | 46 | 64 | 83 | 102 | 120 |
| K = 1/25 | 203 | 287 | 372 | 457 | 543 |

Table 1: Deterministic Simulation, 4 points, number of steps until given accuracy ($10^{-2}, 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6}$) is met.

| Constant | Accuracy | | | | |
|----------|-----------|-----------|-----------|-----------|-----------|
| | 10^{-2} | 10^{-3} | 10^{-4} | 10^{-5} | 10^{-6} |
| K = 1000 | 20 | 25 | 31 | 36 | 41 |

Table 2: Deterministic Simulation, 12 points, number of steps until given accuracy is met.

| Constant | Accuracy | | | | |
|-----------|-----------|-----------|-----------|-----------|-----------|
| | 10^{-2} | 10^{-3} | 10^{-4} | 10^{-5} | 10^{-6} |
| K = 1 | 647 | XXX | XXX | XXX | XXX |
| K = 1/5 | 90 | XXX | XXX | XXX | XXX |
| K = 1/25 | 216 | 344 | 17578 | XXX | XXX |
| K = 1/125 | 969 | 1009 | 1604 | 28292 | XXX |
| K = 1/625 | 4759 | 4851 | 4939 | 6604 | XXX |

Table 3: Stochastic Simulation, 4 points, number of steps until given accuracy is met.

| Constant | Accuracy | | | | |
|-----------|-----------|-----------|-----------|-----------|-----------|
| | 10^{-2} | 10^{-3} | 10^{-4} | 10^{-5} | 10^{-6} |
| K = 1/5 | 11369 | XXXX | XXX | XXX | XXX |
| K = 1/25 | 968 | 56470 | XXX | XXX | XXX |
| K = 1/125 | 1076 | 4071 | XXX | XXX | XXX |
| K = 1/625 | 4637 | 4846 | 15867 | XXX | XXX |

Table 4: Stochastic Simulation, 12 points, number of steps until given accuracy is met.

| Number | Surface | Volume | S / V |
|--------|---------|--------|-------|
| 4 | 4.62 | 0.51 | 9.00 |
| 5 | 7.11 | 0.87 | 8.21 |
| 6 | 6.93 | 1.33 | 5.20 |
| 7 | 7.56 | 1.59 | 4.77 |
| 8 | 8.12 | 1.75 | 4.64 |
| 9 | 8.60 | 2.04 | 4.22 |
| 10 | 8.96 | 2.21 | 4.05 |
| 11 | 9.25 | 2.35 | 3.93 |
| 12 | 9.57 | 2.54 | 3.78 |
| 16 | 10.26 | 2.88 | 3.57 |
| 20 | 10.70 | 3.10 | 3.45 |
| 24 | 11.01 | 3.26 | 3.38 |
| 32 | 11.40 | 3.50 | 3.25 |
| Cube | 8.00 | 1.54 | 5.20 |
| Dodec | 10.51 | 2.79 | 3.78 |
| Sphere | 12.57 | 4.19 | 3.00 |

Table 5: Surface and Volume of the solids

| Number | n^2 | Coulomb Energy | C E / Edges |
|--------|-------|----------------|-------------|
| 4 | 16 | 3.6744 | 0.6124 |
| 5 | 25 | 5.9751 | 0.6639 |
| 6 | 36 | 8.4852 | 0.7071 |
| 7 | 49 | 11.325 | 0.755 |
| 8 | 64 | 13.0432 | 0.8152 |
| 9 | 81 | 17.5749 | 0.8369 |
| 10 | 100 | 21.0024 | 0.8751 |
| 11 | 121 | 24.6996 | 0.9148 |
| 12 | 144 | 28.533 | 0.9511 |
| 16 | 256 | 45.549 | 1.0845 |
| 20 | 400 | 64.8216 | 1.2004 |
| 24 | 576 | 80.214 | 1.3369 |
| 32 | 1024 | 135.666 | 1.5074 |
| Cube | 64 | 10.392 | 0.866 |
| Dodec | 400 | 42.039 | 1.4013 |

Table 6: Values of the energy of the solids

3. Diagrams

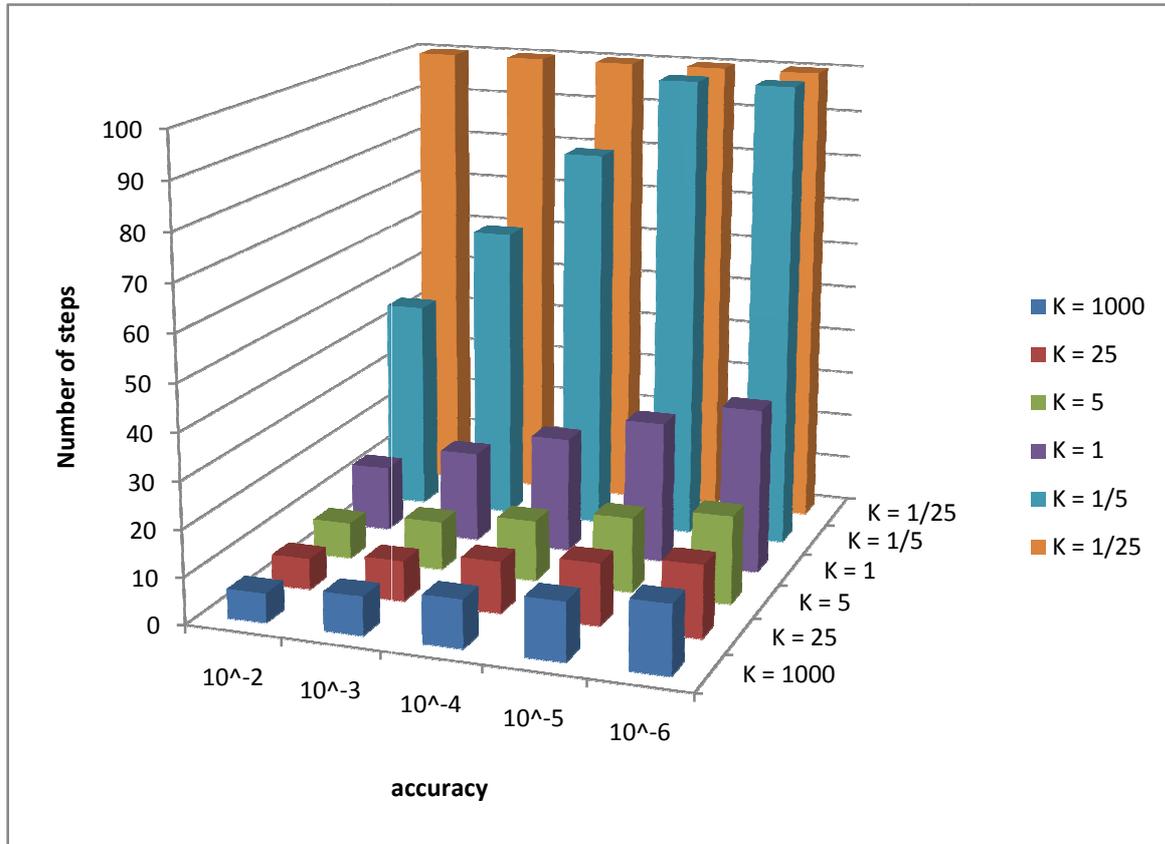


Diagram 1: Number of steps to reaching the required accuracy for the stochastic simulation for 4 points (see also table 1)