

BSPDE_NonUniformGrid

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1 Coordinate transformation for the Black-Scholes PDE

```
In [6]: import numpy as np
import matplotlib.pyplot as plt
```

1.1 Coordinate mapping

The Python function `Smap(·)` below maps the ξ coordinates into S coordinates:

$$S(\xi) := B + \alpha \sinh(c_0 \xi + c_1(1 - \xi)),$$

with $c_0 := \operatorname{arcsinh}\left(\frac{\bar{S}-B}{\alpha}\right)$ and $c_1 := \operatorname{arcsinh}\left(\frac{S-B}{\alpha}\right)$.

```
In [7]: def SMap(xi, SMin, SMax, B, alpha):
    c = arcsinh((SMax - B) / alpha), arcsinh((SMin - B) / alpha)
    return (B + alpha * sinh(c[0] * xi + c[1] * (1. - xi)))
```

1.1.1 Numerical example

```
In [8]: B, SMin, SMax = 50., 0., 100.
```

```
In [11]: xixi = linspace(0, 1, 100)
horizLine = [1. for xi in xixi]
aalpha = [0.01, 10., 100.]
for alpha in aalpha:
    SS = [SMap(xi, SMin, SMax, B, alpha) for xi in xixi]
    plt.figure(figsize=(15, 3))
    plt.title('Non-uniform grid with alpha = %.2f' %
              alpha, fontsize=13, fontweight='bold')
    plt.scatter(SS, horizLine, s=2)
plt.show()
```



