

9.3.2 Gelfand equation

Consider Gelfand equation

$$u'' + (K-1)\frac{u'}{z} + \lambda \exp(u) = 0, \quad u(0) = 0, \quad u(1) = 0, \quad (9.37)$$

where the prime denotes the differentiation with respect z , $K \geq 1$ is a constant, $u(z)$ and λ denote eigenfunction and eigenvalue, respectively.

This nonlinear eigenvalue equation contains a singularity at $z = 0$ and the highly nonlinear term $\exp(u)$. Write $A = u'(0)$. This non-zero eigenfunction and eigenvalue can be found out by means of the **BVPh 1.0**, as shown below.

Fig. 9.13 Eigenvalue versus A of Gelfand equation (9.37) when $K = 1$ and $K = 2$. Solid line: $K = 1$; Dashed line: $K = 2$. Filled circles: exact solution (9.43).

