

## Local projection stabilisation on layer-adapted meshes for convection-diffusion problems with characteristic layers (Part I)

Sebastian Franz<sup>1</sup>, Gunar Matthies<sup>2</sup>

### ABSTRACT

We consider singularly perturbed convection-diffusion problems on the unit square where the solution  $u$  exhibits exponential and characteristic layers. In order to stabilise the discretisation, layer-adapted meshes and the local projection method are applied.

Using bilinears, the error between the solution  $u$  and the finite element solution  $u^N$  converges with first order while the error between  $u^N$  and the bilinear interpolant  $I^N u$  of the solution  $u$  shows second order convergence.

For enriched  $\mathcal{Q}_p$  elements which already contain the space  $\mathcal{P}_{p+1}$ , the error between the solution  $u$  and the finite element solution  $u^N$  shows the convergence order  $p + 1$  in the  $\varepsilon$ -weighted energy norm. Furthermore, the error between  $u^N$  and a special interpolant  $I^N u$  provides the convergence order  $p + 1$  in the local projection norm.

<sup>1</sup>Department of Mathematics and Statistics  
University of Limerick  
Limerick, Ireland  
`sebastian.franz@ul.ie`

<sup>2</sup>Fachbereich Mathematik  
Universität Kassel  
Heinrich-Plett-Strasse 40, D-34132 Kassel, Germany  
`matthies@mathematik.uni-kassel.de`