A well-posed simultaneous space-time minimal residual discretisation of parabolic evolution equations

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We present two mixed simultaneous space-time variational formulations of parabolic evolution equations, with one of them having an equivalent interpretation as a minimal residual method, or a Petrov-Galerkin discretisation with a near optimal test space. We derive sufficient conditions for their stability, and show that these are satisfied by finite element discretizations w.r.t. non-uniform partitions of the space-time cylinder which allow a partitioning into time-slabs. For approximating singularities that are local in space and time, one prefers to avoid the time-slab restriction. We present stable discretizations by subspaces that are spanned by tensor products of wavelets-in-time, and finite elements in space.