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**TSFC: a structure-preserving form compiler.** (English) Zbl 1388.68020


Summary: A form compiler takes a high-level description of the weak form of partial differential equations and produces low-level code that carries out the finite element assembly. In this paper we present the Two-Stage Form Compiler (TSFC), a new form compiler with the main motivation being to maintain the structure of the input expression as long as possible. This facilitates the application of optimizations at the highest possible level of abstraction. TSFC features a novel, structure-preserving method for separating the contributions of a form to the subblocks of the local tensor in discontinuous Galerkin problems. This enables us to preserve the tensor structure of expressions longer through the compilation process than is possible with other form compilers. This is also achieved in part by a two-stage approach that cleanly separates the lowering of finite element constructs to tensor algebra in the first stage, from the scheduling of those tensor operations in the second stage. TSFC also efficiently traverses complicated expressions, and experimental evaluation demonstrates good compile-time performance even for highly complex forms.

**MSC:**
- 68N20 Theory of compilers and interpreters
- 65M60 Finite element, Rayleigh-Ritz and Galerkin methods for initial value and initial-boundary value problems involving PDEs
- 65N30 Finite element, Rayleigh-Ritz and Galerkin methods for boundary value problems involving PDEs

**Keywords:**
code generation; finite element method; form compiler; tensor algebra; weak form

**Software:**
- Firedrake; SyFi; UFL; FIAT; taco; FFC; Eigen; COFFEE; SPIRAL; TSFC; FIAT; TensorFlow; FEniCS; Analysa; CTF; dijitso; FreeFem++; GetDP

**Full Text:** DOI arXiv

**References:**


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