

## Overview of Stanford University Smart Fields Consortium (SFC)

Computational optimization, history matching (data assimilation), uncertainty quantification, and data interpretation are key technologies for modern reservoir management. The Stanford Smart Fields Consortium is a multidisciplinary program that performs state-of-the-art research in these important areas. We investigate a wide variety of approaches, algorithms and enabling technologies for optimization and history matching. A key SFC focus area is the development of deep neural network surrogate models to greatly reduce the computation required for these applications. SFC members are provided access to the *Stanford Unified Optimization Framework*, which is a modular implementation of many of the algorithms developed and evaluated within the group.

SFC mainly includes faculty, students, postdocs and research scientists from the Department of Energy Resources Engineering, though researchers from other departments and visitors are also involved in our research. The program benefits from the computational resources provided by the Stanford Center for Computational Earth and Environmental Science and from interactions with other affiliate programs.

Smart Fields current and recent research areas include:

- Implementation and application of a wide variety of optimization techniques for well placement, well control, history matching, and closed-loop modeling
- Development of deep-learning-based surrogate models for flow simulation and well-response prediction, with application to history matching and optimization
- Deep learning for geological parameterization (for efficient/realistic history matching)
- Deep-learning-based closed-loop reservoir management
- Data science methods for interpreting permanent downhole gauges
- Multifidelity/multigroup approaches for optimization and uncertainty quantification
- Use of machine-learning-based error models in multifidelity optimization
- Treatments for handling geometric constraints in well location optimization
- Optimization under geological uncertainty
- Data-space inversion for history matching and uncertainty quantification
- Development of treatments for model error in history matching
- Application of optimization and closed-loop procedures for oil production, shale gas production, CO<sub>2</sub> storage with geomechanics, and energy systems management

We review our research for member companies each year in a workshop held at Stanford University. Members are provided with fast access to the results of our work, and code developed within SFC is readily available to member companies. You can see many of our recent publications at [https://scholar.google.com/citations?hl=en&user=lb7BrecAAAAJ&view\\_op=list\\_works&sortby=pubdate](https://scholar.google.com/citations?hl=en&user=lb7BrecAAAAJ&view_op=list_works&sortby=pubdate) and [https://scholar.google.com/citations?hl=en&user=f1brNwEAAAAJ&view\\_op=list\\_works&sortby=pubdate](https://scholar.google.com/citations?hl=en&user=f1brNwEAAAAJ&view_op=list_works&sortby=pubdate). We are open to collaboration with members on specific projects. The Smart Fields Consortium is closely integrated with the Reservoir Simulation Research group (SUPRI-B). SFC is directed by Professor Louis Durlofsky. The Smart Fields membership fee is \$50,000 per year. For more information, please contact Louis Durlofsky ([lou@stanford.edu](mailto:lou@stanford.edu)).