FRACKING – THE PRESSURE IS ON

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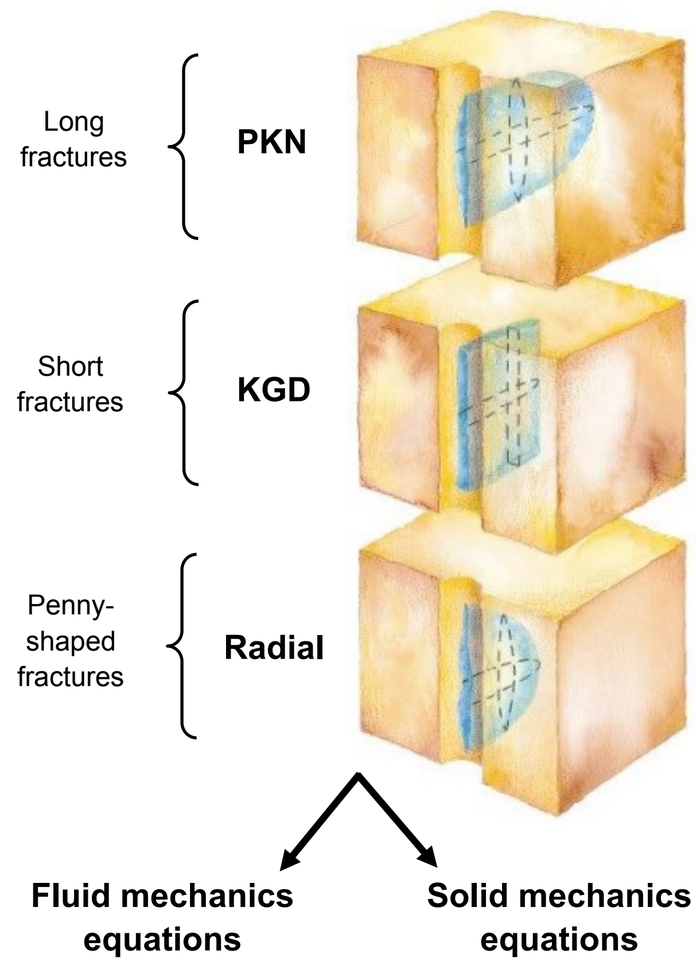
Introduction

Hydraulic fracturing (HF) has caused **controversies** from the time it was first used. There are two **extremely** different opinions – its opponents believe fracking puts our **environment** at risk, while its supporters emphasise **economic benefits**. My research focuses on the construction and evaluation of new, **efficient** computational algorithms to simulate the hydraulic fractures and advance the understanding, control and **security** of the process.

Motivation

- fracking has the potential to **revolutionise** our energy needs or **destroy** our countryside
- scientists and politicians need to have the best possible **understanding** of hydraulic fracturing in order to inform decision-making
- first mathematical models of fracking appeared in the 1950s but we still lack **good, publicly available tools**
- existing commercial packages are expensive and their algorithms secret; the scientific community is therefore deprived of **important information** about their weaknesses
- an **independent platform** for predicting and monitoring fracking is a crucial issue for **environmental security**

Models



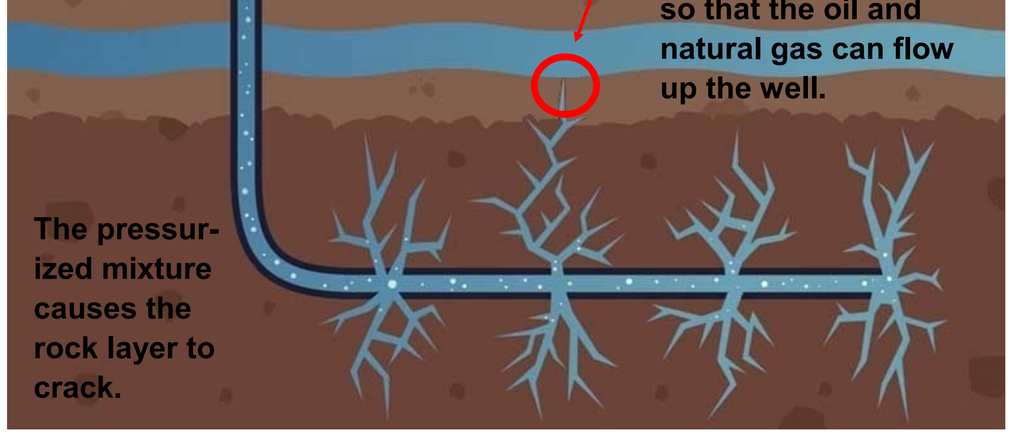
Applications of HF

Nature

- magma driven dykes
- subglacial drainage of water

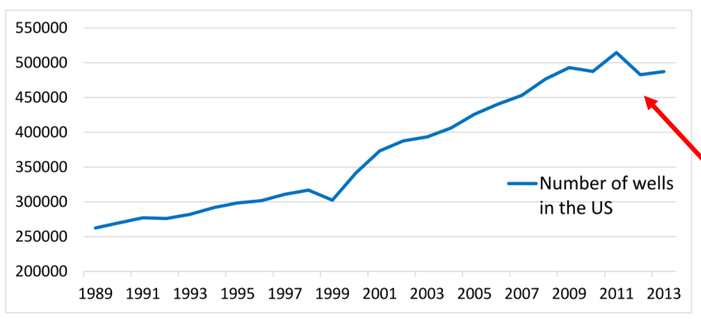
Technology

- stimulation of flow of hydrocarbons from reservoirs
- efficient exploitation of geothermal resources
- methane extraction from coal seams to prevent gas explosions
- storage of dangerous and radioactive waste underground
- *in situ* stress measurements



Challenges

- uncertainties about **geological data** far underground
- **complex** interaction between the **rock** (solid) and the **hydrocarbons** (fluid)
- processes at very small length scales influence the global response
- possibility of highly irregular **crack shapes** and localized spikes in **pressure** in the crack tip
- processes occurring on widely different length and time scales



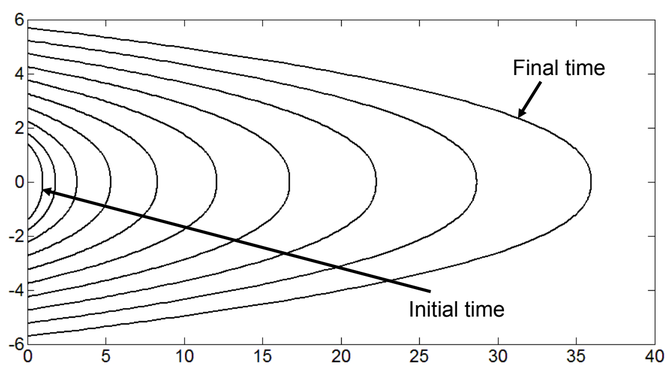
www.eia.gov

More wells = cheaper gas

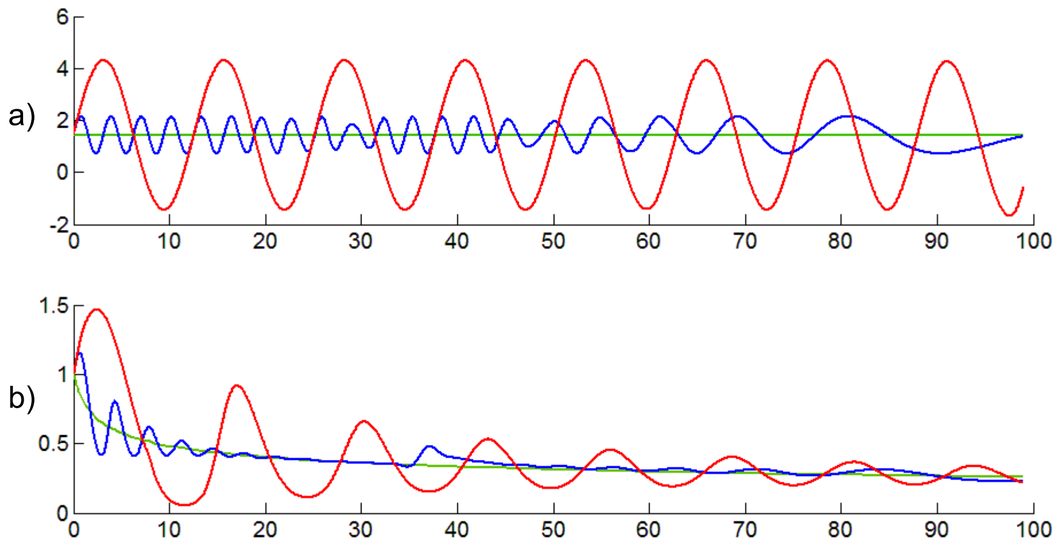
Effective and flexible numerical algorithm

BP Statistical Review of World Energy, June 2014

Crack evolution in time



Relationship between pump-in rate (a) and predicted crack propagation speed (b)



Bibliography

Brady, Elbel, Mack, Morales, Nolte, Poe. *Cracking Rock - Progress in Fracture Treatment Design*

Wróbel, Mishuris. *Particle velocity based universal algorithm for numerical simulation of hydraulic fractures*

Photos: Linda Baker, The Times, legal-planet.org (more details available on request)