RAPID Introduction

Dr. Eric van Oort
Lancaster Professor, Petroleum Engineering
## Agenda - Morning

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Presenter</th>
</tr>
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<tbody>
<tr>
<td>9:30</td>
<td>Coffee &amp; Registration</td>
<td>All</td>
</tr>
<tr>
<td>10:00</td>
<td>RAPID Overview</td>
<td>All</td>
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<tr>
<td>10:00</td>
<td>Welcome Remarks, What is RAPID?</td>
<td>Eric van Oort</td>
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<tr>
<td>10:20</td>
<td>Grad Student Program / Senior Design Projects</td>
<td>Mitch Pryor</td>
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<tr>
<td>10:35</td>
<td>RTOC Applications / Case-based training curriculum</td>
<td>Pradeep Ashok</td>
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<tr>
<td>10:50</td>
<td>Senior Researcher Presentations</td>
<td>All</td>
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<tr>
<td>10:50</td>
<td>Advanced modelling for oil &amp; gas applications</td>
<td>Maggie Chen</td>
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<tr>
<td>11:05</td>
<td>Downhole modelling, kick-detection, MPD</td>
<td>Ali Karimi</td>
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<tr>
<td>11:20</td>
<td>Break</td>
<td>All</td>
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<tr>
<td>11:30</td>
<td>Big data, human factors and decision-making</td>
<td>Pradeep Ashok</td>
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<tr>
<td>11:45</td>
<td>Advanced control, directional drilling, vibration mitigation</td>
<td>Behcet Acikmese</td>
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<tr>
<td>12:00</td>
<td>Intelligent mechanization, drilling automation, simulation</td>
<td>Mitch Pryor</td>
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<tr>
<td>12:15</td>
<td>RAPID Research Summary &amp; Objectives</td>
<td>Eric van Oort</td>
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<td>12:30</td>
<td>Lunch, Tejas Room at the AT&amp;T Executive Center</td>
<td>All</td>
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RAPID RIG AUTOMATION
Performance Improvement in Drilling

May 8, 2015
Kick-off Orientation Meeting
## Agenda - Afternoon

### Selected Graduate Student Presentations

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker</th>
<th>Title</th>
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<tbody>
<tr>
<td>14:00</td>
<td>Roman Shor</td>
<td>Drilling dynamics and control</td>
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<tr>
<td>14:15</td>
<td>Theresa Baumgartner</td>
<td>Making sense of high frequency data</td>
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<tr>
<td>14:30</td>
<td>Adrian Ambrus</td>
<td>Improving quality of drilling data</td>
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<tr>
<td>14:45</td>
<td>Parham Pournazari</td>
<td>Data aggregation &amp; human factors in drilling automation</td>
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<tr>
<td>15:00</td>
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<td>Break</td>
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**Wrap-up**

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker</th>
<th>Title</th>
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<tbody>
<tr>
<td>15:10</td>
<td>Mitch Pryor</td>
<td>RAPID Consortium Details</td>
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<tr>
<td>15:40</td>
<td>Eric van Oort</td>
<td>RAPID Summary, Questions, &amp; Feedback</td>
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<tr>
<td>16:00</td>
<td>All</td>
<td>Social, Gabriel’s at the AT&amp;T Executive Center</td>
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Safety Moment
Attending Companies

- Apache Corporation
- APS Technology
- Aramco Services Company
- AWC
- Baker Hughes
- BHP Billiton
- Canrig
- Chesapeake
- Conocophillips
- Drillmec
- Exxonmobil
- GDS International
- Halliburton
- Heidenhain Corporation
- Huisman Equipment
- Ikon Science
- Mettler-Toledo
- Nabors Drilling
- National Instruments
- NOV
- Oxy
- Peloton
- QRI
- SAS Institute, Inc.
- Schlumberger
- Shell
- Society of Petroleum Engineers
- Statoil
- Transocean
- Weatherford
Rapid – Dictionary Definition

Rapid

**adjective**: rapid; superlative adjective: rapidest
- happening in a short time or at a fast pace.
- synonyms: quick, fast, swift, speedy, expeditious, express, brisk, lightning, meteoric, whirlwind, sudden, instantaneous, instant, immediate;
- **pretty damn quick, PDQ**: “the rapid rise to stardom“;
- characterized by great speed.

**noun**: rapid; plural noun: rapids
- fast-flowing and turbulent part of the course of a river.

_from Latin: rapidus_

To be clear: Rapid
- Not “Rabbit”
- Nor “Rabid”
Who are RAPID: Steering Group

Dr. Mitch Pryor
Dr. Pradeep Ashok
Dr. Behcet Acikmese
Dr. Dongmei “Maggie” Chen
Dr. Mark Reis
Dr. Ali Karimi
Dr. Eric van Oort
Additional Members
RAPID is an interdisciplinary group of researchers and students from multiple engineering disciplines (petroleum, mechanical, and aerospace) with these objectives and goals:

• deliver automation solutions for any and every aspect of well construction (drilling, cementing, completion / stimulation, production?)

• reducing drilling/completion time and cost by > 50%

• reducing the number of individuals at the rig site by > 50%.
How to Achieve RAPID’s Goals & Objectives?

• **Identify resources from both inside and outside of UT Austin**, and actively pursue partnerships with other universities and research institutions around the world to progress well construction automation;

• **Develop automation education, training for the next generation of drilling engineers** who must have automation expertise to facilitate technology transfer to industry;

• **Perform applied basic research, with the emphasis on applied**. RAPID will actively pursue the development of meaningful, practical knowledge and technologies that can be rapidly deployed by member companies;

• **Leverage non-oilfield automation expertise for the oil and gas industry**. Provide focus for long-term, continual research by recruiting outstanding and diverse talent to advance the level of automation from lessons learned both in and outside the oil industry;

• **Provide a new and important arena for industry to come together** to facilitate adoption, standardization and integration in addition to ongoing efforts (SPE DSATS, IADC ART, Roadmap Initiative, etc.);

• **Use consortium meetings as opportunities for member companies to provide input and guidance** as well as prioritize research activities that account for continually advancing industry capabilities.
RAPID’s 4 Key R&D Focus Areas

- Automation control systems
- Modeling, simulation, and empirical validation in downhole environments
- (Real-Time) Monitoring, data analytics, and “Big Data” issues
- Intelligent mechanization, automation, and equipment re-design
RAPID Teaching Focus – Automation “Tracks”

Masters level curricula (30 total hours include 6 hours MS thesis). Early courses will focus on setting a strong foundation in domain fundamentals as well as in automation and control.

PhD Curriculum (estimated 6 additional courses) will by highly customizable. Three potential tracks are shown above exemplifying breadth of course available to consortium students at UT Austin.
What RAPID is **NOT** - 1

- **An effort that is the “pet project” of a single senior professor**
  - ✓ RAPID is a diverse collaboration between junior and senior faculty
  - ✓ RAPID wants to create opportunities for young/minority/female faculty in particular

- **An effort that is strictly limited to the Petroleum Engineering discipline**
  - ✓ RAPID is inherently multi-disciplinary, capitalizing on strengths in different disciplines
  - ✓ Current collaborators come from Mechanical, Aerospace & Petroleum, and we will broaden this to Computational, Electrical, Civil, etc.

- **A consortium without any consideration for field application, generating practical deliverables, etc.**
  - ✓ RAPID’s focus is Applied Basic Research, with emphasis on **Applied**
  - ✓ RAPID will generate deliverables that can be immediately applied to field operations (e.g. OPC-UA standard), in addition to more medium and long-term efforts
What RAPID is **NOT** - 2

• A consortium that is “hands off” w.r.t. sponsoring companies
  ✓ RAPID aims to work closely with sponsors to help improve their field operations based on their well data

• A consortium that will not give access to models, software, etc.
  ✓ RAPID will build a library of downhole models and software that is available to the consortium participants (license fee included in sponsor fee)

• A consortium that companies sponsor only to get access to the students / talent
  ✓ Delivering resources to industry is an important objective, but RAPID’s aim is to be more than just be a mere body-shop for talent

• A consortium that is limited to the Cockrell School and UT Austin
  ✓ RAPID is very open to collaborations beyond the confines of the Cockrell School and UT Austin, working with other universities and research institutes nationally and internationally
Why Automation? Why Now?

Additional Factors
- Operator interest
- ILT > 30%
- Norwegian investment
- Marginal shale economics
- Big Crew Change & recent industry layoffs

Source: SPE DSATS
An Opportunity?

Source: Nasdaq WTI and Natural Gas Price, May 4th, 2015
Improvement Opportunities: ILT & NPT

Narrow, optimized performance distribution for a group of wells, rigs, crews, drillers

Widespread, non-optimized performance distribution for a group of wells, rigs, crews, drillers

Source: Deepwater Horizon Study Group

- ILT > 30%
- Deepwater NPT > 30%
- Land NPT ~ 10 – 20%
Why UT-Austin?

Enabling infrastructure at UT-Austin: (top left) HIL Rig Simulator; (bottom left) Fluids Automation Laboratory (top middle) UT Remote Collaboration Center; (Bottom Middle) Nuclear Robotics Equipment; (Right) Test Well in Basement of PGE Building
## Introducing: UT’s Automation Students

<table>
<thead>
<tr>
<th>Non-RAPID Students (Industry Sponsored)</th>
<th>RAPID Students</th>
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<tbody>
<tr>
<td>• Doug Adams</td>
<td>• Adrian Ambrus</td>
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<tr>
<td>• Theresa Baumgartner</td>
<td>• Ashkan Hosseini</td>
</tr>
<tr>
<td>• Runqi Han</td>
<td>• Melissa Lee</td>
</tr>
<tr>
<td>• Mehran Mehrabi</td>
<td>• Zheren Ma</td>
</tr>
<tr>
<td>• Can Pelihvanturk</td>
<td>• Vinod Kumar Varala</td>
</tr>
<tr>
<td>• Parham Pournazari</td>
<td>• Zhou (“Alex”) Yang</td>
</tr>
<tr>
<td>• Roman Shor</td>
<td>• Dandan Zheng</td>
</tr>
<tr>
<td>• Vivek Singhal</td>
<td>• Undergrads:</td>
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<tr>
<td>• Lin Yang</td>
<td>• Arjun Chintapalli</td>
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<td>• Brandon Benson Hilts</td>
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<td>• Arsha Pourghaffar</td>
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<td>• Brendan Fraser</td>
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What About Current Project Sponsors?

- **Will continue to conduct one-on-one R&D with industry companies**
  - Projects conducted separately from RAPID, separate contract, T&C’s etc.
- **No cross-contamination between RAPID and non-RAPID projects**
  - Current model, systems in place managing 8 different automation projects for 6 different sponsors – confidentiality is guaranteed
  - Only published literature information from non-RAPID projects shared at sponsor meetings (including today!)
- **Will seek longer-term commitments for future one-on-one projects**
  - Commitments of 3-6 months for (teams of) undergrad students
  - Commitments of 2 years for MS students
  - Commitments of 4-5 years for PhD students