

Controls workshop context and goals

- Excellent participation at the GWADW 2015 controls session
- We now have a path forward with the controls group (CSWG)
- Controls for next generation
- We don't have next generation design
- We will start by discussing advanced controls in the context of 2G detectors (Wednesday)
- And will begin to address controls considerations for next generation detectors (Thursday)
- Few presentations, focus on discussion, brainstorming

GWADW2016 - Impact of Recent Discoveries on Future Detector Design

Angular control



Challenging, noise limiting, optimization, integration in early design

Local and global control



FF and FB advanced techniques, stability, sensor noise, cross coupled dofs.

Learning algorithms for tuning global IFO control



Path forward for optimal control
Promising techniques, non-linear correlations

Controls considerations for next generation detectors

List of control problems and options, integration in the early design, working document

Angular control (Jenne Driggers) (Wed, 9:00 - 10:30)

- **Introduction (<30 min)**
 - Describe the problem, limitations in current IFO
 - Describe possible approaches to solve these problems
 - Angular control of Advanced Virgo suspended benches (Michal Vas)
- **Open Discussion/Brainstorming (~60 min)**
 - Radiation pressure induced instability
 - Angular control loops optimization
- **Goals**
 - What do we optimize? (Stability vs Noise, Scattering...)
 - What cost functions?
 - How to produce an optimal sensing matrix ?

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Local and global control (Wed, 9:00 - 10:30)

- **Introduction (<30 min)**
 - Describe limitations of SISO controls (stability, noise...)
 - Describe the types of problems/applications
 - Present and future of superattenuator control system (Valerio Boschi)
 - Using the earthquakes arrival predictor to put the IFO in robust mode (Sebastien Biscans)
- **Open Discussion/Brainstorming (~60 min)**
 - Incorporating control desires into future opto-mechanical design
 - Feed-forward control in the interferometer's cavity basis
 - Adapting to non-guassian and seasonal seismic environments (e.g. earthquake predictions)
 - Paradigm shift in thoughts about angular sensing and control (new / additional sensing schema)
 - MIMO Damping / Modal Damping improvements to local suspension control
 - Optimal Measurement Techniques, Transfer Function Fitting Tools
 - Incorporating control desires into future opto-mechanical design
- **Goals**
 - Estimate complexity/benefits, define a path forward

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Learning algorithms for tuning global IFO control (Dennis/Rana) (Thu, 9:00 - 10:30)

- **Introduction (<30 min)**
 - Describe some capabilities of existing algorithms and applicability to controls
 - Describe the types of problems/applications which may be suitable
- **Open Discussion/Brainstorming (~60 min)**
 - What environmental changes or instrument drifts require re-tuning?
 - Define inputs and outputs
 - Which techniques show promise for which types of problems?
 - Any experience that we as a collaboration have?
- **Goals**
 - List of controls problems to be addressed with machine learning
 - Suggested plans of attack
 - Plan to follow up with the CSWG (volunteer teams and regular review)

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Controls considerations for next generation detectors (Dennis) (Thu, 11:00 - 12:30)

- **Introduction (<30 min)**
 - Brief description of next gen concepts (A+, CV, CE, ET)
 - Some thoughts on controls challenges, considerations for discussion
- **Open Discussion/Brainstorming (~60 min)**
 - Controls challenges for each next generation concept, e.g.
 - CE: Angular stability tradeoff with g-factor for long arms
 - ET-LF: Small bandwidth makes lock acquisition difficult
 - Etc.
 - Common/general controls issues
 - Modulation/readout schemes for observability
 - Arm length stabilization (dichroic coatings) and/or suspension point interferometer?
 - Adequacy or shortcomings of current simulation models
 - Etc.
- **Goals**
 - List of controls problems to be addressed
 - Suggested plans of attack
 - Plan to follow up with the CSWG (volunteer teams and regular review)