

PFN Researcher Interview

Lekan Molu

Smilow Center for Translational Research,
The University of Pennsylvania, Philadelphia, PA

October 04, 2019

Personal Background

PFN
Researcher
Interview

Lekan Molu

Personal
Background

Select Publications

Technical
Presentation

Research Overview

Approach

Problem Setup

Results

- PhD in Electrical and Computer Engineering, University of Texas at Dallas, Richardson, USA. 2014–2019
 - *“A Multi-DOF Soft Robot Mechanism for Patient Motion Correction and Beam Orientation Selection in Cancer Radiation Therapy.”*
- Master of Science in Engineering in Control Systems, The University of Sheffield, Sheffield, United Kingdom. 2012
 - *“Autonomous Navigation of a Rotorcraft Unmanned Aerial Vehicle using Machine Vision.”*

Select Publications

PFN
Researcher
Interview

Lekan Molu

Personal
Background
Select Publications

Technical
Presentation
Research Overview

Approach
Problem Setup

Results

- Mechanism and Constitutive Model of a Continuum Robot for Head and Neck Cancer Radiotherapy.
Olalekan Ogunmolu, Xinmin Liu, Nicholas Gans, and Rodney Wiersma
Submitted to *Robotics and Automation Letters (ICRA 2020)*, September 2019.
- A Fast Deep Learning Approach for Beam Orientation Selection Using Supervised Learning with Column Generation on IMRT Prostate Cancer Patients
Azar Sadeghnejad Barkousaraie, **Olalekan Ogunmolu**, Steve Jiang, and Dan Nguyen.
Submitted to *Medical Physics (An AAPM Journal)*, May 2019.
- Full publications list available at my online [publications page](#).

Select Publications

PFN
Researcher
Interview

Lekan Molu

Personal
Background
Select Publications

Technical
Presentation
Research Overview

Approach
Problem Setup

Results

- Deep BOO: Automating Beam Orientation Selection in Intensity Modulated Radiation Therapy
Olalekan Ogunmolu, Michael Folkerts, Dan Nguyen, Nicholas Gans, and Steve Jiang.
Algorithmic Foundations of Robotics XIII, International Workshop (WAFR), Mérida, Mexico. December 2018.
- Minimax Iterative Dynamic Game: Application to Nonlinear Robot Control Tasks
Olalekan Ogunmolu, Nicholas Gans, and Tyler Summers.
IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Madrid, Spain. October 2018. DOI: 10.1109/IROS.2018.8594037.

Select Research Experience

PFN Researcher Interview

Lekan Molu

Personal
Background
Select Publications

Technical
Presentation
Research Overview

Approach
Problem Setup

Results

- **Visiting Postdoctoral Scholar**, Department of Radiation and Cellular Oncology, Pritzker School of Medicine, [The University of Chicago](#), Chicago, IL, USA. Summer 2019.
- **Postdoctoral Scholar**, Perelman School of Medicine, [The University of Pennsylvania](#), Philadelphia, PA, USA. 2019 - Present.
- **Hardware Integration Intern**, Amazon Robotics LLC, North Reading, MA, USA. 2016.

Technical Presentation

PFN
Researcher
Interview

Lekan Molu

Personal
Background
Select Publications

Technical
Presentation
Research Overview

Approach
Problem Setup

Results

- This page is left blank intentionally.

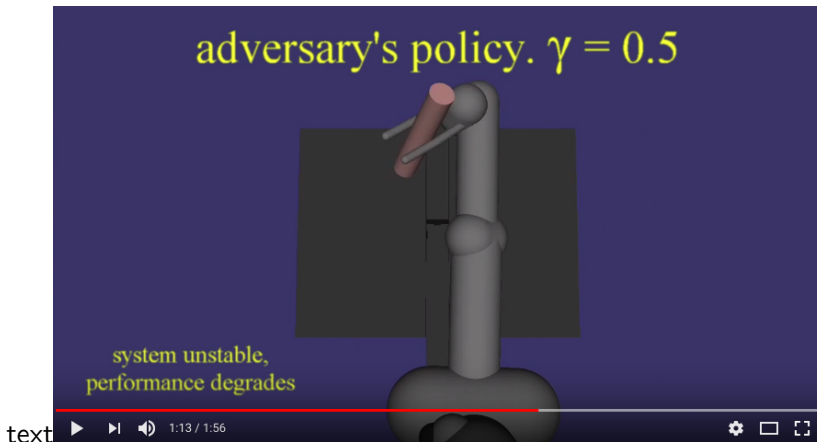
Robustness in Deep Policies: An Overview

**PFN
Researcher
Interview**

Lekan Molu

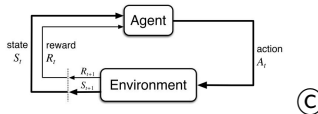
Technical Presentation

Results

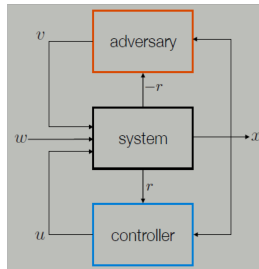


The robustness conundrum

- How to know *a priori* a policy's robustness limits?



- How to inculcate robustness into multistage decision policies?



Problem Setup

- To quantify the brittleness, we optimize the stage cost

$$\max_{\mathbf{v}_t \sim \psi \in \Psi} \left[\sum_{t=0}^T \underbrace{c(\mathbf{x}_t, \mathbf{u}_t)}_{\text{nominal}} - \gamma \underbrace{g(\mathbf{v}_t)}_{\text{adversarial}} \right]$$

- To mitigate lack of robustness, we optimize the *cost-to-go*

$$\mathcal{J}_t(\mathbf{x}_t, \pi, \psi) = \min_{\mathbf{u}_t \sim \pi} \max_{\mathbf{v}_t \sim \psi} \left(\sum_{t=0}^{T-1} \ell_t(\mathbf{x}_t, \mathbf{u}_t, \mathbf{v}_t) + L_T(\mathbf{x}_T) \right),$$

- and seek a saddle point equilibrium policy that satisfies

$$\mathcal{J}_t(\mathbf{x}_t, \pi^*, \psi) \leq \mathcal{J}_t(\mathbf{x}_t, \pi^*, \psi^*) \leq \mathcal{J}_t(\mathbf{x}_t, \pi, \psi^*),$$

Results: Brittleness Quantification

PFN Researcher Interview

Lekan Molu

Personal Background

Select Publications

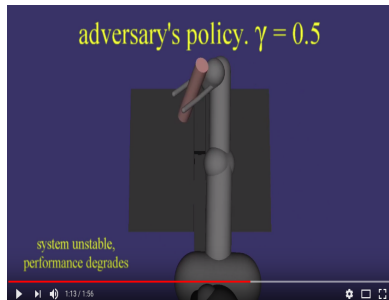
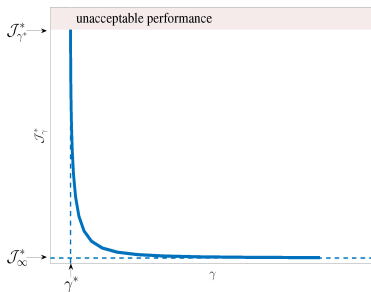
Technical Presentation

Research Overview

Approach

Problem Setup

Results



ILQG Algorithm Example

PFN
Researcher
Interview

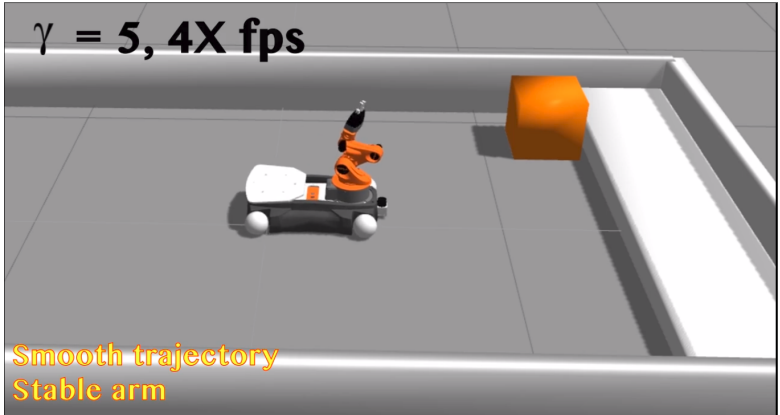
Lekan Molu

Personal
Background
Select Publications

Technical
Presentation
Research Overview

Approach
Problem Setup

Results



Results: Iterative Dynamic Game

PFN
Researcher
Interview

Lekan Molu

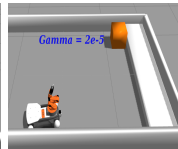
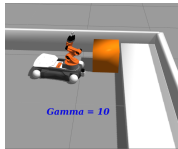
Personal
Background
Select Publications

Technical
Presentation
Research Overview

Approach
Problem Setup

Results

x_1^*



x_2^*

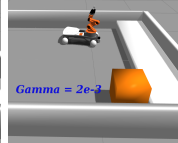
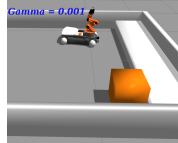


Table: *

End pose of the KUKA platform with our iDG formulation given different goal states and γ -values