# PFN Researcher Interview

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# Personal Background



- 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



- 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 Publications



- 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 Research Experience



- **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, Philadelpia, PA, USA. 2019 - Present.
- **Hardware Integration Intern**, Amazon Robotics LLC, North Reading, MA, USA. 2016.

# Technical Presentation



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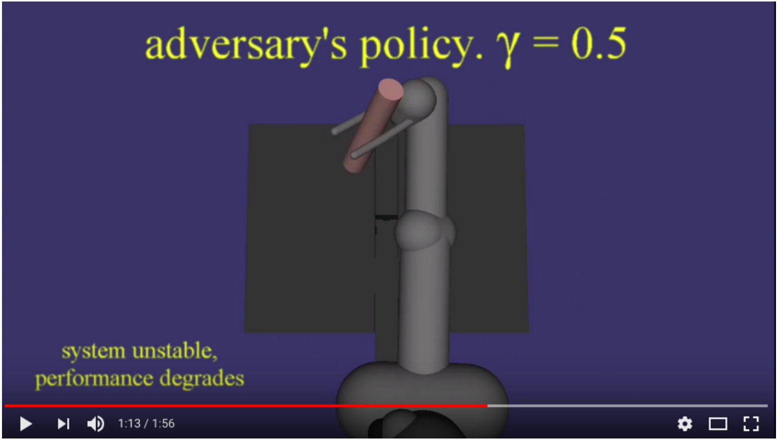
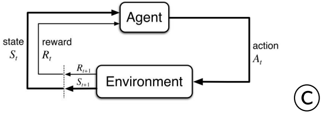
# Robustness in Deep Policies: An Overview



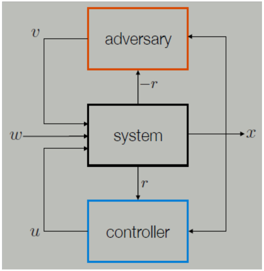
# The robustness conundrum



- 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*

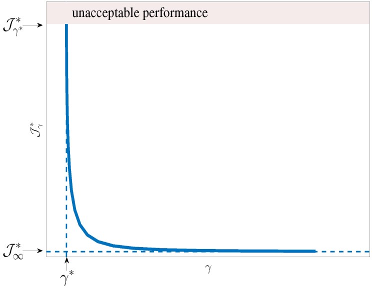
$$\mathcal{J}_t(\mathbf{x}_t, \pi, \psi) = \min_{\mathbf{u}_t \sim \boldsymbol{\pi}} \max_{\mathbf{v}_t \sim \psi} \left( \sum_{t=0}^{T-1} \ell_t(\mathbf{x}_t, \mathbf{u}_t, \mathbf{v}_t) + L_T(\mathbf{x}_T) \right),$$

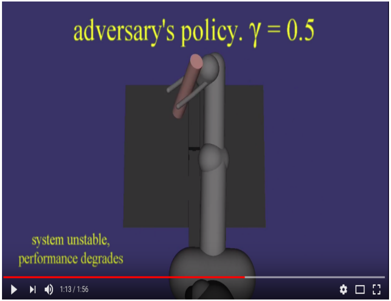
- and seek a saddle point equilibrium policy that satisfies

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

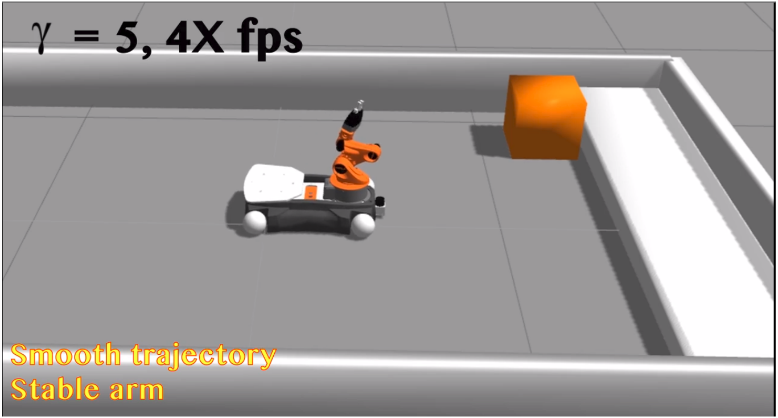
# Results: Brittleness Quantification





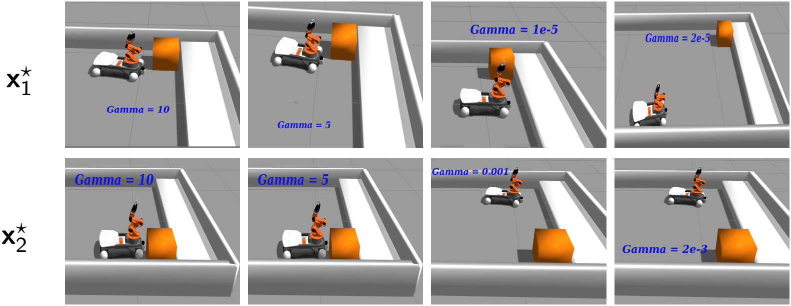



# ILQG Algorithm Example



# Results: Iterative Dynamic Game






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