

# Abhishek Pandala

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## Professional Summary

Senior Robotics and Controls engineer with **7+** years of experience developing and deploying cutting-edge control systems for **humanoid** and **quadrupedal** robots. Demonstrated exceptional efficiency by co-developing a complete real-time software control stack for humanoid locomotion with an ambitious timeline of **5 months** in a **2-person** team. Proven track record of transitioning research innovations into production-ready solutions at companies like Apptronik and Cartwheel Robotics. Expertise spans the full development lifecycle—from algorithm design and simulation to hardware implementation and field testing. Passionate about building robust, scalable robotic systems that push the boundaries of innovation in autonomous robotics.

## Educational Qualifications

- Virginia Polytechnic Institute and State University**, Blacksburg, Virginia (Aug'19 - Dec'23)  
Doctor of Philosophy in Mechanical Engineering, GPA: **4.0/4.0**  
Thesis: **Robust Predictive Control for Legged Locomotion**
- University of Illinois at Urbana-Champaign**, Urbana, Illinois (Aug'17 - May'19)  
Master of Science in Mechanical Engineering, GPA: **3.93/4.0**
- Indian Institute of Technology Madras**, Chennai, India (Jul'12 - Jul'17)  
Dual Degree (B.Tech and M.Tech) in Mechanical Engineering, GPA: **9.26/10.0**

## Industrial Experience

- Senior Software and Controls Engineer, Cartwheel Robotics** (Feb'25 - present)  
Reno, Nevada
- Co-developed the full software stack for real-time planning and control in a **2-person team**, delivering stable bipedal locomotion for the humanoid robot Yogi from concept to deployment in an ambitious **5 months** timespan
  - Conducted comprehensive system identification and calibration, including friction compensation modeling and inertial parameter estimation for all robot links
  - Designed, implemented, and deployed model-based and model-free reinforcement learning controllers on the Yogi humanoid robot platform
- Software Engineer Robotics, Apptronik** (Jan'24 - Jan'25)  
Austin, Texas
- Developed footstep planning system for Apollo humanoid robot using Angular Momentum Linear Inverted Pendulum (ALIP) model, enabling dynamic bipedal locomotion
  - Integrated high-level footstep planner with whole-body controller and successfully deployed solution on hardware, achieving stable and robust walking
  - Improved computational efficiency and enhanced locomotion robustness on Apollo humanoid

## Computer Skills

**Low-Level Programming** : C, C++  
**Scripting Languages** : MATLAB, Python  
**Computational Software** : IsaacSim, Mujoco, RaiSim, Pro-Engineer, AUTODESK Inventor, Simulink Real Time  
**API / Toolkit** : Onnxruntime, CUDA C, SuiteSparse, Docker

## Honors and Awards

- Rudolf Kalman Best Paper Award, ASME Dynamic Systems and Controls Division (2022)
- Best Paper Award Finalist, Technical Committee for Model-Based Optimization of Robotics (2021)
- Rank - 1 in MTech Product Design Stream, Indian Institute of Technology Madras (2017)
- Best Poster Award, ISNT Conference & Exhibition on Non-Destructive Evaluation (2017)
- Boeing Travel Grant to present at the 19<sup>th</sup> WCNDT, Munich (2016)
- DAAD WISE scholarship to pursue an internship at Fraunhofer IZFP, Germany (2015)
- Sanskrit Prathibha Puraskar Award for meritorious performance in class XI Sanskrit examination (2011)
- State Rank - 4 out of 1.3 million students in class X State Board examinations (2010)

## Graduate Research

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### Robust MPC for rough terrain locomotion

(Aug'19 - May'23)

Advisor: **Prof. Kaveh Akbari Hamed, HDSRL Lab, Virginia Tech**

- Developed and analyzed two hierarchical control frameworks for real-time planning and control of quadrupedal robots
- Crafted an event-based MPC framework and theoretically proved the asymptotic stability of desired target point
- Designed and developed a Robust MPC (RMPC) framework to bridge the gap between reduced- and full-order models of locomotion
- Demonstrated significant improvement in the rough terrain locomotion performance of the quadrupedal robot in numerical simulations and experiments

### Control Synthesis of Quadruped Robot

(Aug'17 - May'19)

Advisor: **Prof. Hae-Won Park, Dynamic Robotics Lab, UIUC**

- Developed a unified control framework for quadrupedal robot locomotion using **Linear Model Predictive Control**
- Employed geometric control techniques to avoid singularities and unwinding phenomenon extending the range of dynamically feasible motions
- Developed a custom QP solver, *qpSWIFT*, using Interior Point methods in ANSI C to deploy the control algorithm in embedded platforms at a rate of **350 Hz**
- Validated the control algorithm with various periodic gaits and acrobatic maneuvers in simulations and with experiments on in-house developed quadrupedal robot *PANTHER*

### Numerical Simulation of Elastic waves in Polycrystals

(Jul'16 - Jul'17)

Advisor: **Prof. K. Balasubramaniam, Prof. C. V. Krishnamurthy, CNDE Lab, IITM**

- Developed a simulation framework to study the complex wave scattering phenomenon in heterogeneous medium through Finite Difference Time Domain method
- Analyzed linear elastic wave propagation in **polycrystalline medium** and **nonlinear elastic waves** in isotropic medium
- Proposed wave-localized computations and leveraged data parallelism through **GPU computations** to reduce computational times

## Internships (Research and Industrial)

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### Slowness Surfaces Generation, LENTO

(May'16 - Jul'16)

Advisor: **Prof. Michael Lowe, Prof. P. Huthwaite, NDE Labs, Imperial College London, London, UK**

- Developed a standalone windows application, LENTO that generates slowness surface of a material in three dimensions
- Deployed five open source libraries and software to create the application
- The application is planned to be integrated with **DISPERSE**, a widely used NDE software that calculates dispersion curves for multi layered structures

### Modeling of Elastic waves in Complex geometries

(May'15 - Jul'15)

Advisor: **Dr. Martin Spies, Dept. of Components and Assemblies, Fraunhofer-IZFP, Saarbrücken, Germany**

- Modeled three-dimensional elastic waves in complex components involving circular and phased-array transducers in liquid and solid media
- Validated the efficacy of the 3D FDTD numerical model using a semi-analytical approach based on the superposition of numerically calculated point source elementary waves
- Defects such as flat bottomed holes and side drilled holes were simulated in CPU as well as in GPU taking advantage of massive data parallelism innate to FDTD approach

### Thermal Contact Conductance

(Dec'14 - Jan'15)

Advisor: **Keerthi Gowdaru, Manager, Computational Modeling team, Lam Research, Bangalore, India**

- Developed a MATLAB GUI that helps to accurately estimate thermal contact conductance in bolted as well as cylindrical interfaces
- Case studies using various configuration of bolt radius ratio and number of bolts is performed using the values of pressure obtained from FEM analysis

## Invited Talks and Guest Lectures

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ME 4734, Robotics and Mechatronics Seminar Guest Lecture, Virginia Tech

(Sep'22)

- "Legged Robots"




## Teaching Experience

**Teaching Assistant**, Virginia Tech, ME Department  
– Engineering Analysis Using Numerical Methods, ME 2004










(Aug'21 - Dec'21, Jan'22 - May'22, Aug'23 - Dec'23)

## Publications

### Journal Articles

- [J1] **Abhishek Pandala**, Aaron D Ames, Kaveh Akbari Hamed,  $\mathcal{H}_2$ - and  $\mathcal{H}_\infty$ -Optimal Model Predictive Controllers for Robust Legged Locomotion, IEEE Open Journal of Control Systems, 2024. 
- [J2] **Abhishek Pandala**, Randall T. Fawcett, Ugo Rosolia, Aaron D. Ames, Kaveh Akbari Hamed, Robust Predictive Control for Quadrupedal Locomotion: Learning to Close the Gap Between Reduced- and Full-Order Models, Vol 7, No. 3, pp. 6622-6629, 2022. 
- [J3] Randall T. Fawcett, **Abhishek Pandala**, Aaron D. Ames, Kaveh Akbari Hamed, Robust Stabilization of Periodic Gaits for Quadrupedal Locomotion via QP-Based Virtual Constraint Controllers, IEEE Control Systems Letters, Vol 6, pp. 1736-1741, 2022. 
- [J4] Randall T Fawcett, **Abhishek Pandala**, Jeeseop Kim, Kaveh Akbari Hamed, Real-Time Planning and Nonlinear Control for Quadrupedal Locomotion with Articulated Tails, Journal of Dynamic Systems, Measurement, and Control, Vol. 143, No. 7, 2021. 
- [J5] Yanran Ding, **Abhishek Pandala**, Chuanzheng Li, Young-Ha Shin, Hae-Won Park, Representation-Free Model Predictive Control for Dynamic Motions in Quadrupeds, IEEE Transactions on Robotics, Vol. 37, No. 4, pp. 1154-1171, 2021.  
- [J6] Kaveh Akbari Hamed, Jeeseop Kim, **Abhishek Pandala**, Quadrupedal Locomotion via Event-Based Predictive Control and QP-Based Virtual Constraints, IEEE Robotics and Automation Letters, Vol. 5, No. 3, pp. 4463-4470, 2020. 
- [J7] **Abhishek Pandala**, Yanran Ding, Hae-Won Park, qpSWIFT : A Real-time Sparse Quadratic Program Solver for Robotic Applications, IEEE Robotics and Automation Letters, Vol. 4, No. 4, pp. 3355-3362, 2019.  
- [J8] S. Shivaprasad, C. V. Krishnamurthy, **Abhishek Pandala**, Anuraag Saini, Adithya Ramachandran, Krishnan Balasubramaniam, Numerical modelling methods for ultrasonic wave propagation through polycrystalline materials, Transactions of the Indian Institute of Metals, Vol. 72, No. 11, pp. 2923-2932, 2019. 
- [J9] S. Shivaprasad, **Abhishek Pandala**, C. V. Krishnamurthy, Krishnan Balasubramaniam, Wave localized finite-difference-time-domain (FDTD) modelling of scattering of elastic waves within a polycrystalline material, The Journal of the Acoustical Society of America, Vol. 144, No. 6, pp. 3313-3326, 2018. 
- [J10] **Abhishek Pandala**, S. Shivaprasad, C. V. Krishnamurthy, Krishnan Balasubramaniam, Robust and efficient finite-difference-time-domain modeling of the propagation of nonlinear elastic waves, Badania Nieniszczace i Diagnostyka, Vol. 2, pp. 11-21, 2018. 

### Conference Articles

- [C1] **Abhishek Pandala**, Randall T. Fawcett, Ugo Rosolia, Aaron D. Ames, and Kaveh Akbari Hamed, Robust Predictive Control for Quadrupedal Locomotion: Learning to Close the Gap Between Reduced- and Full-Order Models, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), October 2022. 
- [C2] Randall T Fawcett, **Abhishek Pandala**, Aaron D Ames, Kaveh Akbari Hamed, Robust stabilization of periodic gaits for quadrupedal locomotion via QP-based virtual constraint controllers, American Control Conference, 2022. 
- [C3] **Abhishek Pandala**, Vinay R. Kamidi, Kaveh Akbari Hamed, Decentralized Control Schemes for Stable Quadrupedal Locomotion: A Decomposition Approach from Centralized Controllers, International Conference on Intelligent Robots and Systems (IROS), pp. 3975-3981, 2020. 
- [C4] Joseph B Martin, Vinay R. Kamidi, **Abhishek Pandala**, Randall T. Fawcett, Kaveh Akbari Hamed, Exponentially stabilizing and time-varying virtual constraint controllers for dynamic quadrupedal bounding, International Conference on Intelligent Robots and Systems (IROS), pp. 3914-3921, 2020. 
- [C5] Kaveh Akbari Hamed, Vinay R. Kamidi, **Abhishek Pandala**, Wen-Loong Ma and Aaron D. Ames, Distributed Feedback Controllers for Stable Cooperative Locomotion of Quadrupedal Robots: A Virtual Constraint Approach, American Control Conference (ACC), pp. 5314-5321, 2020. 
- [C6] **Abhishek Pandala**, Yanran Ding, Hae-Won Park, qpSWIFT : A Real-time Sparse Quadratic Program Solver for Robotic Applications, International Conference on Intelligent Robots and Systems (IROS), 2019.  
- [C7] Yanran Ding, **Abhishek Pandala**, Hae-Won Park, Real-time Model Predictive Control for Versatile Dynamic Motions in Quadrupedal Robots, International Conference on Robotics and Automation (ICRA), pp. 8484-8490, 2019.  
- [C8] S. ShivaPrasad, **Abhishek Pandala**, Krishnan Balasubramaniam, C. V. Krishnamurthy, Numerical modeling of three-dimensional elastic wave propagation in Polycrystalline media, Non Destructive Evaluation, Thiruvananthapuram, India, December 2016.

[C9] **Abhishek Pandala**, S. Shivaprasad, C. V. Krishnamurthy, Krishnan Balasubramaniam, *Modeling of Elastic Wave Scattering in Polycrystalline Materials*, 8<sup>th</sup> International Symposium on NDT in Aerospace, Bangalore, India, November 2016.



[C10] **Abhishek Pandala**, Krishnan Balasubramaniam, Martin Spies, *Simulation of Ultrasonic Inspection of Complex Components Using A 3D-FDTD Approach*, 19<sup>th</sup> World Conference on Non-Destructive Testing, Munich, Germany, June 2016.



## Publication Reviews

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### Journals

current

- IEEE Transactions on Robotics (TRO)
- IEEE Robotics and Automation Letters (RAL)
- IEEE/ASME Transactions on Mechatronics

### Conferences

current

- IEEE American Control Conference (ACC)
- IEEE International Conference on Decision and Control (CDC)
- IEEE International Conference on Robotics and Automation (ICRA)
- IEEE International Conference on Intelligent Robots and Systems (IROS)

## Community Service

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### Transparent Chennai, NGO

Jun'17 - Dec'17

Chennai, India

- Aggregated and analyzed critical data and research about civic issues faced by Chennai
- Developed maps of various bus routes in Chennai using GPS tracker

### National Service Scheme, India

Jun'17 - Dec'17

Chennai, India

- Assisted the children of IITM staff to improve their scholastic aptitude through the project Teach Your Neighbor
- Created awareness in people through project Bessi for an eco-friendly, clean Besant Nagar beach