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Objectives: Building / Deploying Successful Neural Network Solutions (100% Remote)

Education: Bachelor Aerospace Engineering, Auburn University, Auburn, Alabama

Artificial Intelligence related Professional Blogs and Websites:
Personal tech blog with Neural Network articles:
- https://mikescodeprojects.com/2020/01/12/pyrenn-vs-matlab/ with downloadable source code
- https://mikescodeprojects.com/2020/01/05/ai-helicopter-control/
- https://mikescodeprojects.com/2021/01/31/keep-it-simple/
- https://mikescodeprojects.com/2021/02/07/neural-network-performance-shaping-preview/
- https://mikescodeprojects.com/2021/02/27/good-data-means-fast-neural-network-training-times/

Twitter account:
- Neural Networks for stock selection - https://twitter.com/aistockforecast

YouTube account – Neural Network tutorials:
- Learning to Apply Neural Networks – Tutorial 1: https://youtu.be/dnazn9xnTCA,
  Tutorial 2: https://youtu.be/Sis-xTcP76w, and Tutorial 3: https://youtu.be/o_HM1J27WOg

Brief Summary of Neural Network Applications Experience:
Neural Network Development Tools:
- Training Frameworks: Pyrenn (https://pyrenn.readthedocs.io/en/latest/) and Matlab Deep Learning toolbox.
- Languages for code base development: Matlab and Java.

Neural Network Applications Built:
- **2021 – Consulting:**
  - Currently teaching a 2-week AI course for engineers of a small aerospace company.
  - Developed a Neural Network machine vision (perception) application.
- **2015 – Present (Home Project)** – Developed a stock market (equities) performance prediction algorithm (very intense data science effort) – currently adding new features and capabilities.
  - Tech blog - https://mikescodeprojects.com/2021/04/15/neural-network-stock-selector/
- **1996 & 2021** - Developed a Neural Network control system for a simulated cart with inverted pendulum test bed using the Performance-Shaping technique – see video of simulation below.
  - https://mikescodeprojects.files.wordpress.com/2021/02/cart_pend_demo.mp4
  - I conceived of the original concept in 1996 and it was used in Mr. Michael Ried's Master's Thesis - https://ecommons.udayton.edu/graduate_theses/5169/
- **2020:** Conceived of an approach for countering adversarial hypersonic missiles using Neural Networks to map the dynamics domain space (DoD program) – partially developed the code base.
- **2012:** Developed a real-time Neural Network guidance system for a DARPA-funded powered-parafoil Unmanned Aerial Vehicle (UAV) program:
  - Video of flight test via Google Virtual Earth - https://youtu.be/bhBnOthL9Mw
- **2010:** Developed Neural Network perception module for road edge-detection applications, which accurately computed start of road edge and road edge angle for each image.
  - https://mikescodeprojects.files.wordpress.com/2021/08/picture3.jpg
  - https://mikescodeprojects.files.wordpress.com/2021/08/picture1.jpg
- **2002-2009**: Developed a real-time Neural Network flight control system for UAV helicopters:
  - https://mikescodeprojects.files.wordpress.com/2021/01/nnet_heli_composition.mp4
  - https://mikescodeprojects.com/2020/01/05/ai-helicopter-control/
  - Awarded patent in 2004 - https://www.google.com/patents/EP1642181A4?cl=en
- **1999:** Developed a Neural Network to perform structural analysis for a NASA Phase-II SBIR contract– the system predicted stress areas with 100% accuracy with extremely short run times.
- **1991 – 1994:** Developed Neural Network closed-loop and open-loop guidance algorithms for simulated spacecraft re-entering planetary atmospheres and exiting into capture orbit.
  - https://mikescodeprojects.files.wordpress.com/2021/08/nnet_guidance.png
  - Simulation with graphics (closed-loop aerocapture guidance) - https://youtu.be/3bKmHycpnhE
- **1993:** Article in AI Magazine which included some of my Neural Network research efforts:
  - https://aaai.org/ojs/index.php/aimagazine/article/view/1047/965
- **1992:** Developed Neural Network open-loop RAAN-Steering guidance for ascent vehicle analysis.
  - https://mikescodeprojects.files.wordpress.com/2021/08/raan-steering.png

Summary of Neural Network Applications Work Experience

Note: The work history summary is not always contiguous time-wise, as this resume only represents my Neural Network applications experience and omits my other engineering experiences.

Consulting Efforts   May 2021 - Present
Neural Network Applications:
- Teaching a 2-week AI (Neural Network) course for engineers of a small aerospace company.
- Developed Neural Network image perception module for autonomous vehicle system software.

Personal Neural Network Projects   2015 to Present
Various Neural Network Application Development Efforts:
Developed a Neural Network algorithm to perform stock market (equities) performance prediction.
- Algorithm analyzes previous stock history and predicts a percentage price increase or decrease for the specified time period - https://mikescodeprojects.com/2021/04/15/neural-network-stock-selector/.
- Currently adding new features and capabilities.
Continued research and development with cart with inverted pendulum simulation testbed to demonstrate the building and testing of Neural Network controllers and demonstrated the Performance-Shaping technique.
- https://mikescodeprojects.files.wordpress.com/2021/02/cart_pend_demo.mp4
Building tutorial packages for future patrons of my new Patreon site - https://www.patreon.com/realAI.

Penta Research, Inc.   August 2019 to May 2021
Neural Network Hypersonic Missile Dynamics Mapping:
Introduced the group to Neural Network technology using the German-designed Pyrenn Neural Network Matlab & Python libraries. Conceived of an approach for countering adversarial hypersonic missiles using Neural Networks to map the dynamics domain space – partially developed the code base.

Logos Technologies   August 2011 to Sept 2012
Neural Network Real-Time UAV Guidance:
Designed Neural Network guidance algorithm for real-time closed-loop flight control software (coded in C, running in Linux) with waypoint navigation for DARPA-funded powered-parafoil Unmanned Aerial Vehicle (UAV) program.
- Powered Parafoil UAV guidance flight test video – "fly through" viewed in Google Earth
  - https://youtu.be/bhBnOthL9Mw
- Designed / coded the UAV Ground Control Station software (Matlab)
  - 1st view - https://mikescodeprojects.files.wordpress.com/2021/08/uav-ground_control_station-gui-1.png
  - 2nd view - https://mikescodeprojects.files.wordpress.com/2021/08/uav-ground_control_station-gui-2.png
- Designed the avionics layout and hardware integration. Avionics hardware components included Attitude & Heading Reference System (AHRS), NovAtel GPS board (navigation sensor also provided local magnetic declination values to the flight software), motor controller board, RS-232 interfaces, and PC104 stack.

Mosaic ATM   Sept. 2009 to March 2010
Neural Network Perception - Road-Edge Detection:
Designed/coded/tested Neural Network perception algorithm for road edge detector application. System successfully generated road edge starting coordinates and the slope relative to the image.
- example 1 - https://mikescodeprojects.files.wordpress.com/2021/08/picture1.jpg
- example 2 - https://mikescodeprojects.files.wordpress.com/2021/08/picture3.jpg

Neural Robotics, Inc.   June 2002 to April 2009
Neural Network Real-Time UAV Flight Control:
Designed Neural Network inner-loop (20 Hz control) and outer-loop (10 Hz guidance) algorithms for real-time closed-loop flight control software (coded in C), for small helicopters with 2-stage turbine, gas, and electric power plants.
- Flight performance examples with different helicopter airframes (start @ 34 seconds)
  - https://mikescodeprojects.files.wordpress.com/2021/01/nnet_heli_composition.mp4
- Designed and tested the various flight modes including precision landing. This video shows a precision landing with GPS (start at 5 minutes, 40 seconds – note that the RC pilot was there only to take over if there were any issues) - https://youtu.be/YhMmkRHn-14.
  - Neural Network flight control modules performed filtering of sensor noise and latencies.
- Designed the avionics layout and hardware integration. The avionics hardware design aspect of the effort included selection and test of sensor and computing hardware – specifically PC104 boards, RS-232 interfaces, GPS board & antenna (navigation sensor), AHRS, servo controller boards, and ultrasonic sensor (later phased out).

- o https://mikescodeprojects.files.wordpress.com/2021/08/nri_avionics.png
- Successfully demonstrated robust control system performance (including actuators, sensors, etc.) with worst-case disturbances:
  - o Attached sling-loads (30+ feet) and flew in gusting winds (video): https://youtu.be/B5xKLtrTI_k.
  - o Flew UAV helicopters in gusting and turbulent winds of up to 50 mph.

  - o Other Neural Network helicopter flight control system performance examples include:
    - Hover while tracking man on ground (video): https://youtu.be/0fSXS5on8nE.
    - Live fire exercises at Fort Benning (video): https://youtu.be/QkAyVUqGpVk.

bd Systems Inc. (acquired by SAIC in 1996)   Oct. 1998 to Sept. 2000
<u>Neural Network Stress Analysis Algorithm:</u>
Developed alternative (fast) Neural Network approach for a NASA Phase-II SBIR contract – used Singular Value Decomposition to extract salient features of the data thereby reducing processing time by two orders of magnitude. The system predicted stress areas with 100% accuracy with extremely short run times

The Boeing Company   Sept. 1989 to Oct. 1997
<u>Neural Network Spacecraft Flight Control Algorithm Development:</u>
Lead AI engineer for group of 6 engineers performing various types of Neural Network applications research and development.
- Developed Neural Network closed-loop guidance algorithms for spacecraft aerocapture simulations. The Neural guidance system had the ability to successfully maneuver the spacecraft into the user-specified target orbit via roll-control of the lift vector during the pass through the atmosphere.
  - o Aerocapture Apoapsis control simulation (image):
    - https://mikescodeprojects.files.wordpress.com/2021/08/aerocapture.png
    - Video of simulation - https://youtu.be/3bKmHycpnhE
  - o Simultaneous Aerocapture Apoapsis & Periapsis control (image):
    - https://mikescodeprojects.files.wordpress.com/2021/08/nnet_guidance_1.jpg
    - https://mikescodeprojects.files.wordpress.com/2021/08/nnet_guidance.png
  - o Tested Neural guidance system performance with worst-case disturbances / system changes – in all cases the Neural Network closed-loop guidance algorithm performance far exceeded the performance of Boeing and Draper Labs predictor-corrector algorithms. Successfully tested the guidance performance by adding worst-case scenarios to include:
    - Variable and nonlinear atmosphere density profile values,
    - latency in the roll-control steering vector response, and
    - errors in the aerodynamic model coefficients.
- Developed Neural Network closed-loop guidance algorithm for simulated aero-entry and landing – guidance system successfully achieved all constraints for landing coordinates and terminal velocity.
  - o Re-entry / landing simulation (image):
    - https://mikescodeprojects.files.wordpress.com/2021/08/landing.png
- Developed a Neural Network guidance module to successfully perform RAAN (Right Ascension of the Ascending Node) Steering for launch vehicle analysis.
  - o Neural Network RAAN-Steering simulation results (image):
    - https://mikescodeprojects.files.wordpress.com/2021/08/raan-steering.png
- Recipient of Boeing Special Incentive Award for Neural Network Guidance Research - August 1992.