AG2PI SEED GRANT - PROJECT FINAL REPORT

PROJECT NAME	**An AI Toolkit for Video Phenotyping in Livestock**

PROJECT PRINCIPAL INVESTIGATOR	TODAY'S DATE	PROJECT START DATE	DATE OF COMPLETION
Samantha Brooks	8-18-2023	6-1-2022	7-31-2023
TEAM MEMBERS (co-PI, co-I, personnel)		COLLABORATORS	
Madelyn Smythe, Kyle Allen, Adam H. Biedrzycki, João Bittar			

ACCOMPLISHMENTS

Please provide a short summary of the conclusions (both successes and failures) made from your project. Include a description of how this project will provide benefits to the agricultural genome to phenome community and, possibly, to a broader audience. You should include both qualitative and quantitative details, as necessary, to support your conclusions. Include a short accomplishment statement in non-technical language and do not include names.

This is not a technical report. Please keep to no more than 6-8 sentences (e.g., 1-2 sentences per point, above).

Locomotor and behavioral phenotypes continue to be one of the greatest challenges in genomics. In this work we have significantly reduced the bottlenecks in two points in the workflow for using AI-based digital video pose estimation employing the DeepLabCut package. First, we created pre-trained models for sheep, pig, indicine cattle, taurine cattle and horses. Downloadable from our website (http://www.ufequinegenetics.org/deep-on-the-farm.html) these models improve the accessibility of this approach, enabling those with little experience in Python, or limited access to computing hardware to begin applying this approach. Second we developed a GUI interface for visualy evaluating DLC labeling results and calculating a few commonly used parameters for evaluating locomotion and lameness in livestock (https://github.com/jakeshirey/DeepLabCut-Display). The addition of these two resources will catalyze use of the powerful DeepLabCut package for high-throughput phenotyping of livestock, enabling research studies to pursue genomic selection for healthier livestock.

Products

Please list any products from this project. This may include (but not limited to) publication, concept/white paper, workshop, conference presentation, website, publicly available data or pipelines, etc. Reminder: you are required to make your prodcuts available to the broader stakeholder community using standard USDA practices, open source, FAIR, or other models. Metrics may include number of participants or times accessed, etc. Include links to recordings, DOI, etc. when possible. For presentations and posters, provide authors, date, location and presentation title.

ACTIVITY / PRODUCT	DESCRIPTION (include URL, if applicable)	OUTCOME / METRICS
Presentation	Johns, L., M. Smythe, S. Dewberry, E. Staiger, K. Allen, and S. Brooks. 2023. "33 Assessing the effect of fatigue on stadium jumping penalty scores in elite three-day event horses utilizing artificial intelligence." Presented June 6th, Dallas Texas, Equine Science Society Symposium. Abstract published: *Journal of Equine Veterinary Science* 124:104335.	https://doi.org/10.1016/j.jevs.2023.104335
Presentation	Rahael, H., M. Smythe, S. Dewberry, A. Oberdorfer, K. Allen, and S. Brooks. 2023. "44 Detecting conformational differences in Fragile Foal Syndrome carriers utilizing artificial intelligence." Presented June 6th, Dallas Texas, Equine Science Society Symposium. Abstract published: *Journal of Equine Veterinary Science* 124:104346.	https://doi.org/10.1016/j.jevs.2023.104346
Presentation	Smythe, M., S. Dewberry, E. Staiger, K. Allen, and S. Brooks. 2023. "45 Quantifying gait quality changes in fragile foal syndrome carriers using artificial intelligence." Presented June 6th, Dallas Texas, Equine Science Society Symposium. Abstract published: *Journal of Equine Veterinary Science* 124:104347.	https://doi.org/10.1016/j.jevs.2023.104347
Publication	Smythe, M., Dewberry, S., Staiger, E.A., Allen, K., Brooks, S., (2023) Performance analysis of Fragile Foal Syndrome carriers in the sport horse	

	population *Journal of Heredity* [In Prep]	
Publication	Smythe, M., Dewberry, S., Staiger, E.A., Allen, K., Brooks, S., (2023) Digital Video Analysis Reveals Changes in Gait Among Three-Day Event Horses During Competition *Journal of Equine Veterinary Science* [In Review]	
Publication	Shirey, J., Smythe, M., Dewberry, S. Allen, K., Jain, E., and Brooks, S. A. (2023) Technical Note: DeepLabCut-Display: open-source desktop application for visualizing and analyzing two-dimensional locomotor data in livestock, *BioRxiv*	BioRxiv link in progress
Presentation/ Poster	Quantifying Locomotor Phenotypes in the Horse with Artificial Intelligence Smythe, M., Dewberry, S., Gupta, V., Nikejad, N., Staiger, E.A., Bao, Y., Allen, K., Brooks, S. A. (2023) Plant and Animal Genome Conference, San Diego CA, January 15th 2023.	https://pag.confex.com/pag/xxix/meetingapp.cgi/Paper/45738
Web resource	Downloadable pre-trained models for one animal, moving left to right across the field of view, 1080p, 120fps. Sheep, pig, indicine cattle, taurine cattle and horse.	http://www.ufequinegenetics.org/deep-on-the-farm.html
Software	DeepLabCut-Display Utility	**https://github.com/jakeshirey/DeepLabCut-Display**

Audience

With whom has this work been targeted to and shared? Please describe how this project and its products have been disseminated to a community of interest. Include any outreach activity or information sharing as well as training or professional development opportunities provided in this project.

To date, our dissemination efforts have focused on the scientific community thorugh conferences and pblicaitons. We don't believe this is sufficent for a tool-building project. We would love to host workshops do online trainings and produce more user-oriented materials, but we've simply run out of funding. We don't have enough budget to hire the effort needed to put on these activities.

CONTINUATION OF WORK

Next steps

How do you/your team plan to continue moving this project forward? Include how AG2PI can assist in your forward momentum.

Our collaborative team recently submitted a USDA-NIFA-AFRI seed grant with hopes that the additional funding will provide the support needed to complete the draft toolkit constructed with the AG2PI proposal.

Outreach

In what ways are you able to stay engaged with AG2PI? (check boxes as appropriate)

- ☒ Will present at a field day
- ☐ Will lead a training workshop
- ☒ Would like to participate in any future AG2PI conference
- ☒ Work with AG2PI on a news release on project conclusions
- ☒ Will continue attending AG2PI events
- ☐ Other (please explain)