RESEARCH PROGRESS REPORT SUMMARY

Grant 03045-A: Artificial Intelligence and Machine Learning for Diagnosis of Dog Sperm Morphology

Principal Investigator: Leonardo Brito, DVM, PhD

Research Institution: University of Pennsylvania

Grant Amount: $12,422.16

Start Date: 7/1/2022 **End Date:** 12/31/2024

Progress Report: End-Year 2

Report Due: 6/30/2024 **Report Received:** 6/17/2024

(The content of this report is not confidential and may be used in communications with your organization.)

Original Project Description:

Sperm morphology evaluation is an important component of dog fertility analysis. However, visual evaluation of sperm morphology is difficult to teach, and results are largely dependent on the proficiency and experience of the evaluator, leading to large variability in results within and across evaluators. The objective of this pilot study is to explore recent advances in artificial intelligence for image pattern recognition, similar to that used by the likes of Google and Facebook, to create an automated method for sperm morphology evaluation. A large database with 10,000 dog sperm images will be created. The images will be evaluated by expert veterinarians, then used to train a Convoluted Neural Network (CNN) using deep learning methods. Investigators expect to generate an algorithm capable of classifying sperm morphology with greater than 90% accuracy and precision. Employing such an algorithm could allow veterinarians to establish more reliable reference values and guidelines for prospective stud dogs and for semen to be used for artificial insemination, improve veterinarian's abilities to formulate diagnoses and prognoses for infertility problems related to specific sperm defects, and to establish the reproductive safety of drugs and compounds.

Publications:

None to date.

Presentations:

None to date.

Report to Grant Sponsor from Investigator:

Semen samples from 62 dogs have been used to build an image database containing 11,464 images of a single sperm obtained using phase-contrast under 1000X magnification. Three specialists are currently classifying the images and building an annotated database to be used to train and test an optimized algorithm for sperm morphology classification. Considerable progress was made on the development of a neural network for sperm evaluation. Two methods to standardize image size proved satisfactory, with image stretching resulting in better accuracy when compared to use of black borders. Additional possibilities for improving the performance of the implemented model will be investigated, including adjusting training hyperparameters, performing preprocessing alternatives such as contour detection before feeding the neural network, and optimizing the neural network architecture itself. Other techniques, such as regularization, insertion of normalization layers, and dropout, are also suggested to achieve better results.

The Principal Investigator requested and was awarded a no-cost extension to 12/31/2024.