# **Elanco BCS Project: Methods**

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#### **Elanco BCS Project Abstract**

PURDUE UNIVERSITY.

This team coordinated with Purdue University's Data Mine and Elanco Animal Health in order to solve an issue regarding pet's health centered around an animal's body condition score.

Body condition score, or BCS is defined as a scale usually used by veterinarians to rate the overall condition of a pet (https://raleighncvet.com). Not many pet owners are aware of their animal's BCS score and during this past year, it may be difficult or unsafe to travel to a vet's office.

The project's goal is to analyze the different body composition scores of dogs through methods in computer vision.

Currently, the team is developing a calculator to determine the body condition score a veterinarian would use for basic health monitoring, through a simple to use, Android app.

Below is the nine-level Nestle-Purina BCS system. This is the system that the team used for this project.

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## 🔀 Nestlé PURINA **BODY CONDITION SYSTEM** Ribs, lumbar vertebrae, pelvic bones and all bony prominences evident from a distance. No discernible body fat. Obvious loss TO P Ribs, lumbar vertebrae and pelvic bones easily visible. No palpable fat. Some evidence of other bony promin Ribs easily palpated and may be visible with no palpable fat. Tops of lumbar vertebrae visible. Pelvic bones becoming prominent. Obvious waist and abdominal tuck. Ribs easily palpable, with minimal fat covering. Waist easily noted, viewed from above. Abdominal tuck evident. Ribs palpable without excess fat covering. Waist observed behind ribs when viewed from above. Abdomen tucked up when viewed from side. Ribs palpable with slight excess fat covering. Waist is discernible viewed from above but is not prominent. Abdominal tuck apparent. Ribs palpable with difficulty; heavy fat cover. Noticeable fat deposits over lumbar area and base of tail. Waist absent or barely visible. Abdominal tuck may be present. Ribs not palpable under very heavy fat cover, or palpable only with significant pressure. Heavy fat deposits over lum area and base of tail. Waist absent. No abdominal tuck. Massive fat deposits over thorax, spine and base of tail. Waist and abdominal tuck absent. Fat deposits on neck and limbs. Obvious abdominal distention. 9 ordry D, Bortges JW, Meyers T, et. al. Comparison of loady for estimates by deal energy screy absorptionetry and deaterizen oxide dilation in client owned dags. Comparison 2001; 22 (24): Jamme DP. Development and Validation of a body fraudo-Knoly, et. al. Effects of Diet Restriction on Life Span and Age-Related Changes in Dogs. JAVMA 2002; 220:1215-1320 Coll 1-800-222-VETS (8387), weekdays, 8:00 a.m. to 4:30 p.m. CT

### Data: Storage and Use

Use:

- A:T Ratio: The abdominal to thoracic ratio, taken by dividing the abdominal region by the thoracic region
- Abdominal & thoracic regions marked up using vertical lines across a silhouette image.
- Lines created through Sobel Operator, Statistical, and DeepLabCut methods.



#### Storage:

- · At first, we marked up images on the slack channel
- We are now using a student's laptop to store images from the app.
- We plan to eventually store all data on scholar.

DeepLabCut Method

DeepLabCut is a neural network-based software

Methods behind the toolbox: transfer learning with

package for animal pose estimation.

## **Sobel Operator Method**



#### Sobel Operator demonstration diagram

- The team used Sobel-Feldman Operator to draw the horizontal and vertical lines that defines the estimated AT score of the dog within the picture.
- The Sobel Operator was implemented by using a 3 by 3 kernel that extracts "edge" features.
- By applying the kernel twice on the image with opposite directions, the team managed to get the intersection of the body with front leg and hind leg, respectively.

**Problems/Future Goals** 

Estimating BCS for all types of dog breeds

· The stats-based approach uses the highest

standard deviation from the center point M, to

determine R1 and R2, which may not always be

The center of the image is not always the center

of the dog with the stats-based approach.

require large data set for training.

## Statistical Method

#### Calculate the top middle of the dog (label M).

- Calculate the standard deviation ( $\sigma$ ) of black pixel column sums for each black pixel column left and right from M.
- If the σ exceeds some range R1 (left) or R2 (right) draw a red line downwards until we encounter a white pixel. The ratio of the red lines will be our AT ratio

Labeled diagram with points of interest, using the stats-based approach.



#### Conclusion/Acknowledgements

#### Conclusion:

The team tried many methods to determine an AT ratio, to determine A BCS score. These three were the most successful

- DeepLabCut: Using deep neural network to track body parts.
- Stats-based: Using standard deviation of column sums.
- Sobel operator: Using kernels to extract features.

#### Acknowledgements:

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The team would also like to acknowledge former members who helped with the project: Daniela Chanci Arrubla, Juan Antonio Barragan, Kourtney Masterson, and Emily Moritz.

#### References:

https://raleighncvet.com (formal BCS definition) Can you Estimate Body Composition in Dogs from Photographs? (paper on BCS in dogs) Mathis, A. et al. (2018) (paper on DeepLabCut)

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# deep convolutional neural networks.



- waist in frames extracted as training data.
- be analyzed and the output (x, y) coordinates of labelled body parts can be used to calculate the chest
- By calculating the A:T ratio of each frame of the video
- analyzed, a distribution of A:T ratio can be generated.

- Label the top and bottom side of a dog's chest and
- After the neural network is trained, a new video can

## length, waist length and then the A:T ratio.

**Future Goals:** Improve the current approaches to generating

accurate

Problems:

- an A:T ratio, to generate a more accurate BCS score. (Accurate) • Make sure the model performs well across
- various breeds of dog with different features. (Robust)
- · Upload all data onto a scholar directory as it has more space than a student's laptop. (Scalable)

