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Cheetah's tail imparts aerodynamic forces and torques – UCT study

A first-of-its-kind detailed study by University of Cape Town (UCT) academics, published by *Biology Open*, has demonstrated the potential of the cheetah's long, furry tail to impart torques and forces on the body as a result of aerodynamic effects.

"This is the first paper to quantify the aerodynamics of the cheetah tail and to my knowledge is the first study to investigate the use of appendage aerodynamics for terrestrial animal stabilization," said Dr Amir Patel, lecturer in the Department of Electrical Engineering.

The study, titled *Quasi-steady state aerodynamics of the cheetah tail*, investigated two distinct sections of two cheetah tails, mid-section and tip.

"The effective area on the mid-section of both tails is nearly double the frontal area of the tail without fur, allowing an increase in aerodynamic forces without significant mass penalty," said Patel.

The tail tip measurement demonstrated effects on the body during manoeuvres.

"During the wind tunnel tests, we observed that the very long fur on the tail tip tended to collapse at higher air-speeds (>20 m/s) but this deformation of the tip fur was not observed in video footage of cheetahs performing rapid manoeuvres," the study explained. "This implies that the tail may potentially exert even greater forces on the body than we have estimated."

Patel points out that although it was commonly believed that the cheetah tail was heavy and it used this weight to balance at high-speed. However, it was confirmed during several autopsies that the tail was not as heavy as it was commonly thought (only ~2% of the body mass) and it was quite thin once the fur was removed.

"We discovered that the thick, bushy fair creates aerodynamic force which the animal can use for stabilisation without the need for a heavy or high inertia tail," said Patel.

In line with UCT Science Faculty Ethics policy, the study used tails from two euthanised cheetahs from the National Zoological Gardens of South Africa.

"From a biological perspective, it furthers our understanding of this animal and its incredible adaptations for high-speed manoeuvrability," said Patel. "My research interest is bio-inspired robotics and this information will directly feed into the design for future agile robots".

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