

## **How Do You Study Flying Snakes? Forget the Cult Movie Snakes on a Plane**

NVIDIA



Snakes that soar — not winged serpents out of mythology, but actual snakes that can glide surprisingly long distances — inhabit the tropical forests of India and Southeast Asia. And even for scientists, they’ve been a bit of a mystery.

How is it that these long, skinny reptiles manage to glide so far? And, if you’re a scientist, how do you study their complex behavior in detail, without having to travel to the far reaches of the earth?

The answer: a GPU-accelerated computer model that, for the first time, is being used to study the aerodynamic factors behind this fascinating phenomenon.

[Lorena Barba](#) [1], associate professor of Mechanical and Aerospace Engineering at the George Washington University in Washington DC, is leading a team that is simulating the aerodynamics of flying snakes using a home-grown computational fluid dynamics (CFD) application and a Tesla K20 GPU accelerator.

### **Today: Flying Snakes. Tomorrow: Flying Robots?**

Researchers often look for inspiration from nature to help solve problems in the mechanical world. In the case of flying snakes, nature has presented a remarkably elegant solution. Whether to escape a predator, find food or just get from place to place, the snakes can glide as far as 21 meters, or close to 70 feet.

Barba’s team not only modeled the aerodynamics of flying snakes in detail, but her work readies the way for research that can potentially be applied to other fields.

This includes the development of futuristic [“micro-air vehicles.”](#) [2] tiny aerial robots as small as insects that can be used in commercial, research and military applications.

Colored electric green with orange highlights, the *Chrysopelea paradisi* species, also known as the paradise tree snake, is a particularly skilled pilot. Not only can this three-foot-long, mildly venomous serpent glide long distances, it can turn while in mid-air.

The snakes start by launching themselves from tree branches. As they plummet toward the ground, they flatten the underside of their bodies by rotating their ribs forward and outward to increase surface area.

At the same time, they rapidly undulate in an S-like shape, becoming a continuously reconfiguring “wing,” which allows them to glide.

It’s amazing to watch: [http://www.youtube.com/watch?v=3vhgC\\_g1cmU](http://www.youtube.com/watch?v=3vhgC_g1cmU) [3]

## **GPU-Accelerated CFD Sheds Light on “Lift”**

In planning her research, Barba was primarily interested in studying one of the most intriguing aspects of the snakes’ flying ability.

At a certain angle of attack (the trajectory of the snake with respect to the air flow), a wind tunnel experiment using models of the snake’s body showed a peculiar increase in aerodynamic lift. It’s unclear if flying snakes in the wild use this extra lift, but it’s an intriguing possibility for future study.

By running sophisticated GPU-accelerated CFD simulations — often used to study the dynamics of how airflow interacts with and affects planes, cars and other vehicles — Barba’s team was able to model and confirm that optimal aerodynamic lift occurs at a 35 degree angle of attack.

In addition, computer simulations let Barba’s Ph.D. student, Anush Krishnan, repeatedly vary a number of environmental conditions, such as velocity and angle of attack, and observe the details of air rotation — which is impossible to study experimentally.

This gave them a high degree of confidence that they had re-created what is occurring in the experiments with a physical model.

## **Up Next: “Flying Snakes 3D”**

Barba and her team learned a tremendous amount about the aerodynamics of flying snakes using a single Tesla GPU in her desktop computer. But the initial simulations were limited to a 2-D cross-section of the snake body.

Next, she plans to add additional GPUs to build highly complex 3-D models of the entire body, which she hopes will further explain how these snakes fly with such

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efficiency.

For now, Barba encourages other researchers to expand upon her work. The CFD application, running scripts and data needed to replicate this work are shared online, for free.

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## **Links:**

[1] <http://lorenabarba.com/>

[2] [http://en.wikipedia.org/wiki/Micro\\_air\\_vehicle](http://en.wikipedia.org/wiki/Micro_air_vehicle)

[3] [http://www.youtube.com/watch?v=3vhgC\\_g1cmU](http://www.youtube.com/watch?v=3vhgC_g1cmU)