70. Duck Drive Components in Endurance Experiments
UFO Doctor, July 19th, 2013

1. Introduction

The tiny DC Gear motor SGM12-N20 (SONTH, HK) is used here to move a robotic duck. Two motors actuate the left and right legs, equipped with webbed feet like a real duck.

The first outdoor swimming experiment was impressing, see video Nr. 69 below:
http://ufo-doctor.ch/descriptions/A_The%20Duck%20Project/69.%20Video%20My%20Robotic%20Duck,%20July%204th,%202013.MP4

However we observed a severe endurance problem:
After 0.45 h laboratory experiments at 5V supply the gear broke twice!
The reason could be that we used the reverse mode, slowly moving the feet to the front and fast with full power backwards.
This might generate too much torque to the gear.

2. Endurance investigation in laboratory conditions

- Normal mode (this means webbed foot moves fast forward and slowly, but with power backward)
- One webbed foot only, not foldable (left and right toe blocked)
- Power supply 5V with 0.4A current limitation

2.1. Test Setup

Fig. 2.1a: Overview Test Setup
1: Rubber string for prestressing force
2: Thread to drag force sensor (vertical angle about 20 deg)
3: Drag force sensor
4: Storage scope
5: Average current meter
6: Power supply
7: Terminal for Motor and Sensor cables

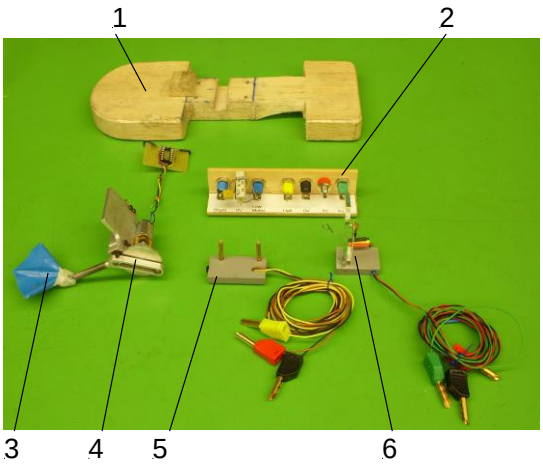

Fig. 2.1b: Detail of the Test Setup
1: Balsa Wood platform
2: Terminal with Motor Shunt/Filters
3: Webbed Foot (here not foldable)
4: Drive unit
5: Hall-Sensor (mounted on motor for synchronization)
6: Drag Force Sensor, Huba Control CH, Type 410 (Sensitivity 0.95V/N)

3. Test Results

- Top: Synchronization: foot at full backward position, starting the recording, 0.5VDiv
- Middle: Current, Voltage at 1 Ohm Shunt, 0.2V/Div or 0.2A/Div
- Below: Drag Force Sensor, Sensitivity 0.95N/V, 0.5V/Div

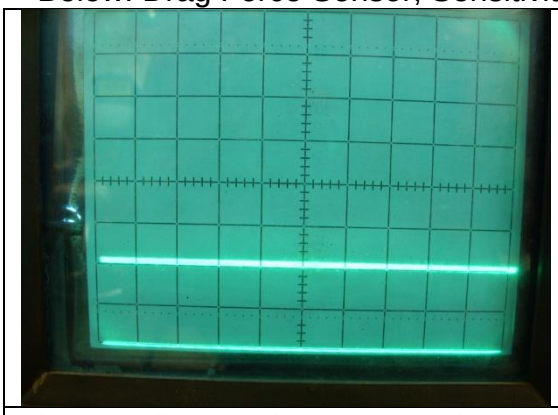

Fig. 3a: All scope inputs to Gnd,
Force Sensor Zero at 1V

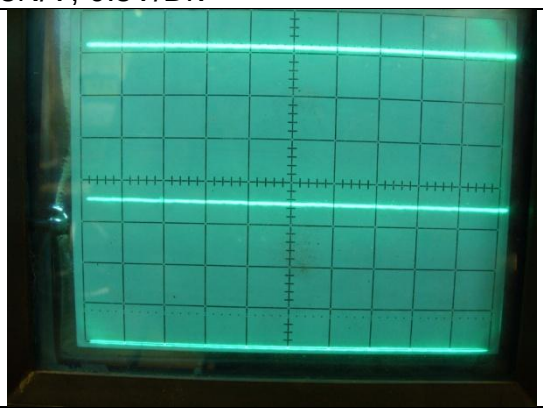

Fig. 3b: Motor switched off
Prestress at Drag Force Sensor of 1.5N

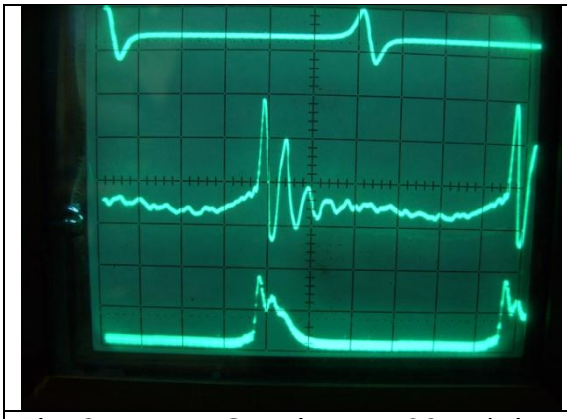

Fig. 3c: Motor Supply 4V, 100ms/Div
Max Current: 380mA
Average Current: 50mA
Stroke force: 1.25N

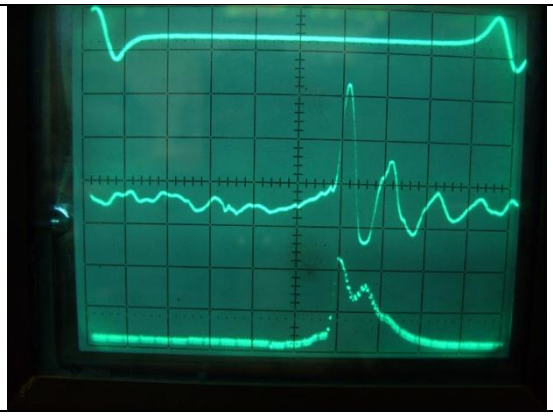

Fig. 3d: Motor Supply 5V, 50ms/Div
Max Current: 470mA
Average Current: 70mA
Stroke force: 1.4N

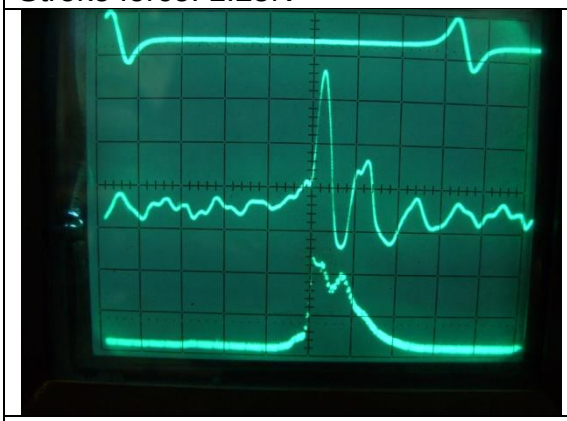

Fig. 3e: Motor Supply 6V, 50msec/Div
Max Current: 480mA
Average Current: 95mA
Stroke force: 1.65N

Fig. 3f: Broken gear wheel after 45 minutes, 3 similar experiments.
The torque is too much, even at normal mode!

4. Comment: We need another motor with 3x more torque!