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# Experimental Study of Low Speed Turning Flight in Cockatoos and Cockatiels

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**An experimental study measuring the kinematics and neuromuscular activation patterns of turning flight in two bird species, cockatiels and rose-breasted cockatoos, was conducted to investigate the aerodynamic and neuromuscular asymmetries underlying avian maneuvering flight. Several individuals from both species were trained to perform turns while flying at low speed, ~3 m/s, through a netting corridor containing a 90 deg turn. During the turn the birds' wing and body motions were measured with multi-camera high-speed videography. Analysis of these measurements showed that: 1) changes in heading occur exclusively in the downstroke phase of the wingbeat cycle, 2) changes in heading were accomplished by redirection of net aerodynamic force via body roll angles of up to 75 deg, 3) roll torque was generated during downstroke, and 4) the torque was the result of bilateral asymmetries in feathering angle and flapping amplitude. Despite large differences in body mass, ~300 g *versus* ~75 g, the cockatoos and cockatiels performed similarly with respect to turning rate and radius of turn. The cockatiels made more consistent use of flapping amplitude asymmetries.**

## Nomenclature

| | | |
|---|---|---|
| $c$ | = | wing chord |
| $C_r$ | = | coefficient of resultant force |
| $f$ | = | flapping frequency |
| $I_x$ | = | moment of inertia about the X axis |
| $L_p$ | = | roll damping coefficient |
| $R$ | = | wing length |
| $\hat{r}$ | = | non-dimensional wing length |
| $v$ | = | wing velocity |
| $\beta$ | = | roll angle |
| $\dot{\beta}$ | = | roll velocity |
| $\ddot{\beta}$ | = | roll acceleration |
| $\theta$ | = | flapping amplitude |
| $\rho$ | = | air density |
| $\tau_l$ | = | torque due to the left wing |
| $\tau_r$ | = | torque due to the right wing |
| $\psi$ | = | heading |
| $\dot{\psi}$ | = | rate of change in heading |

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