A cormorant (skarv)

SKARV

Preventing bird strikes through active control of wind turbines

(Norwegian: Slippe fuglekollisjoner med aktiv regulering av vindturbiner)

Karl Merz (karl.merz@sintef.no) and John Olav Tande, SINTEF Energy Research
Amund Skavhaug and Dag Sjong, Norsk Automatisering AS

- Detect the presence of birds with sensors such as low-cost digital video cameras or radars.
- Based on these measurements perform a probabilistic estimate of the birds' flight path.
- Control the rotational speed of the wind turbine to minimize the probability of collision.

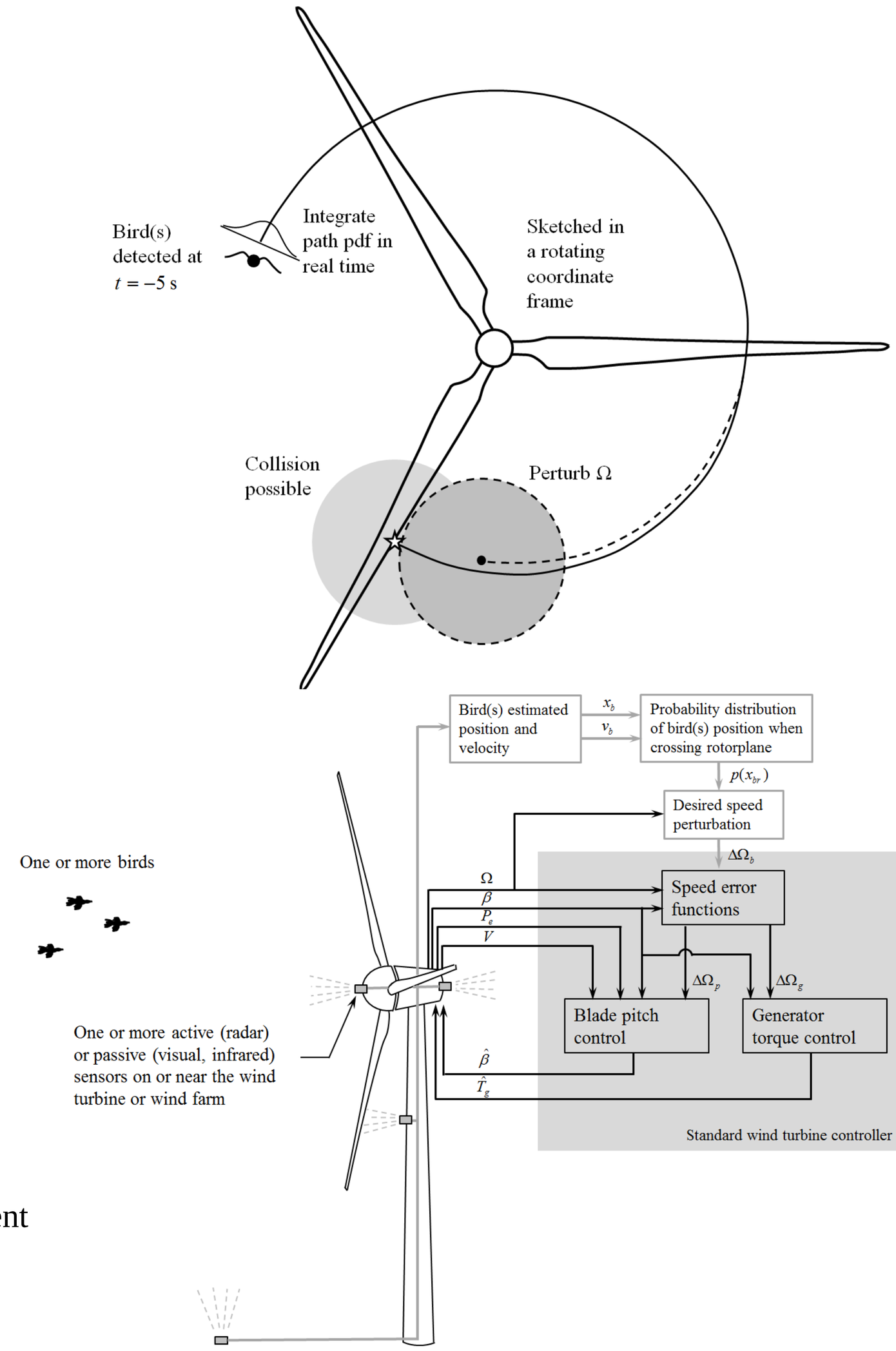
The wind turbine remains in normal operation. The rotor speed is only perturbed by a moderate amount. This requires that the birds be detected and tracked at least several seconds before they cross the rotor plane.

In contrast to existing technologies which employ deterrents such as sounds and lights, the proposed system is entirely benign, avoiding disturbances to the birds and surrounding nature. If successful, the proposed active bird-avoidance control strategy would prevent most bird-blade collisions, with a negligible impact on annual energy production.

Challenges:

Detecting Birds Approaching the Rotor:
Detection and tracking must be done with equipment that is cheap on a per-turbine basis. There are two strategies which could be feasible: installing inexpensive instrumentation on every turbine, or installing a small number of more expensive sensor systems to cover an entire wind farm.

Predicting flight path: The proposed concept requires that the flight path of a bird be characterized mathematically by a probability density function which can be integrated over time, to obtain the probability distribution of the location of the bird at some future time. The model of bird flight does not need to be highly sophisticated, since the computed estimates are continually updated by the tracking data. An initial case for study will be white-tailed eagles at Smøla, for which satellite tracking data has been collected. Radar tracking data of migrating species, in the vicinity of offshore wind farms, is also available, as are some observations on the behaviour of birds near wind turbine rotors.



Preventing bird strikes: The success of the idea hinges upon the ability to detect and predict the probability distribution of the flight paths of birds far enough ahead of time that a small correction to the rotational speed is sufficient to provide an effective reduction in the probability of collision.

Keeping dynamic loads low: The dynamic response of the turbine places constraints on the type of control actions that are feasible. Abrupt acceleration and deceleration of the rotor implies large fluctuating forces in the pitch actuators and turbine structures. Thus the earlier that the bird is detected, the fewer the number of false alerts, and the earlier that the control action is initiated, the more benign the consequences for fatigue of turbine components.