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# Application of a Remote Controlled Ultralight Air Vehicle (UAV) for Park Management and Visitor Monitoring

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## Introduction

For efficient park management it is a necessity to have detailed information about the natural-spatial environment of the park, their changes as well as the amount, behaviour and the spatial distribution of the visitors in a high spatial and temporal resolution. From remote sensed images some of these important information concerning vegetation and vegetation dynamics, animal tracks, erosion etc. can be derived. But the "classical" remote sensed images have limitations. Satellite images often don't have the desired spatial and temporal resolution and the acquisition of aerial photos is expensive.

Also data about the frequency and spatial behaviour of visitors are necessary to develop management strategies. For visitor monitoring numerous techniques exist. A good description of different methods can be found in Muhar et al. (2002). He stated that the use of aerial imagery as a monitoring method is limited due to its high cost and the fact that only single snapshots of recreational use are taken.

## Methods

The remote controlled UAV (ultralight air vehicle) can be a solution for these problems. It is comparatively cheap, light, easy to handle and to fly and can provide aerial photos in a very high spatial resolution and in the desired temporal resolution.

It is a remote controlled air vehicle with a 5.5 hp strong 2-stroke engine and a weight of approximately 6 kg. A payload of 5.5 kg can be carried. The frame of the UAV hangs at a special type of parachute which serves as a wing (figure 1). This allows a slow and stable flight and also guarantees high safety in case of a failure of the motor. The sensor carrier is gimbal-mounted. Different sensors (digital cameras, video cameras, multispectral cameras, etc.) can be mounted. The instantaneous field of view is transmitted to the operators an can be seen on special goggles or a (laptop) screen. Pictures are taken via remote control. The actual position of the UAV which is taken by a GPS is also transmitted to the operator. A maximum flight speed of 25 km/h can be reached. This restricts the use of the UAV for wind conditions lower than 6 m/s. A maximum flight height of 4500 m and an operation distance up to 5 km are possible. The length of the runway is dependant on the wind conditions and varies between 5 m and 25 m. A detailed description of the UAV and its applications can be found in Thamm and Judex (2006).

## Results / Conclusion

Some of the advantages and disadvantages of the UAV are listed in table 1.

Some examples of the successful use of the UAV and its contribution to park management and visitor monitoring will be presented:

- Contributions to park management in the Penjari national park in Benin including vegetation monitoring, change detection and hydrological questions as well as fire management.

Table 1: Some advantages and disadvantages for the use of the UAV.

| Advantages | Disadvantages |
|---|---|
| • Very high spatial resolution (up to 1 cm) dependent on sensor and flight height<br>• High temporal resolution<br>• Coverage of greater areas in short time<br>• Various sensors can be used (e.g. optical, multi-spectral, thermal,..)<br>• Low cost compared to "classical" remote sensing<br>• Comparatively easy to operate and to maintain<br>• Lightweight, easy to set up and to transport<br>• Standardised semi automatic image processing possible | • Depended on weather conditions (wind, mist, rainfall)<br>• In some areas complex permit procedures<br>• Optical sensors have restrictions (Monitoring of processes under closed canopy not possible – thermal sensors could overcome this problem)<br>• Possible disturbance of animals has to be taken into account<br>• Operator should have visual contact with the UAV |

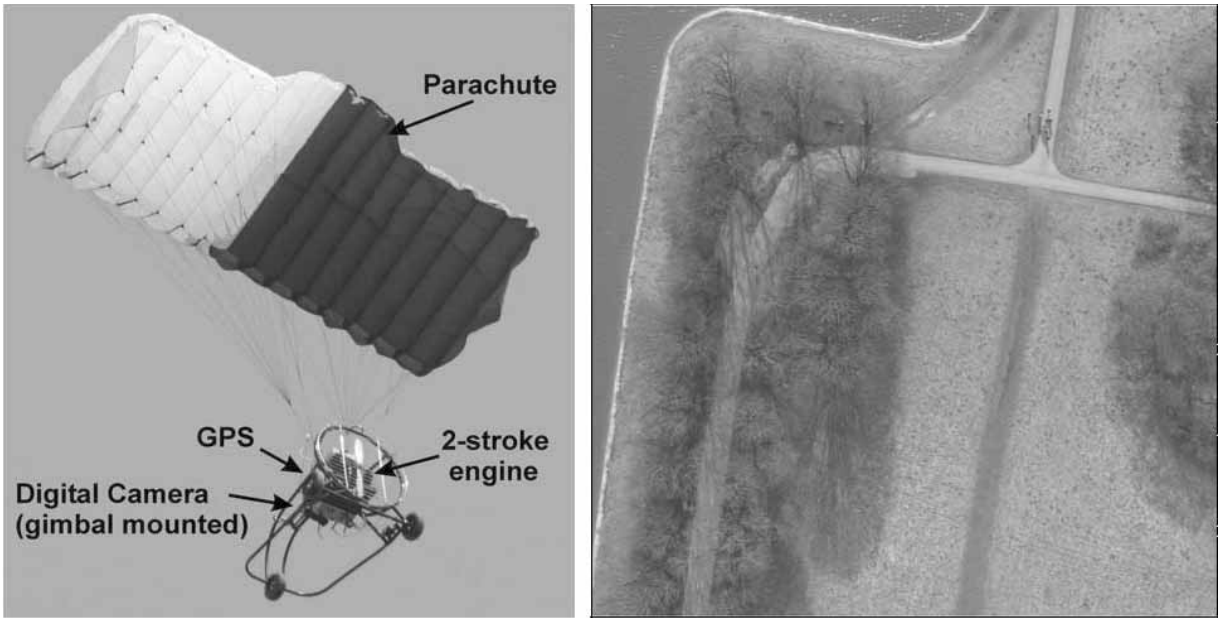


Figure 1: Picture of the UAV (left), image taken by the UAV for visitor monitoring in an urban recreation area in Cologne, Germany.

- Feasibility study for visitor monitoring with the UAV as addition to traditional monitoring systems in urban recreation areas in Cologne, Germany.
- Mapping of ski and animal tracks in the Black Forest.

Furthermore numerous application fields are possible – from landscape photography to derivation of high resolution digital terrain models. Due to the comparatively low costs and high usability the UAV is a very interesting tool.

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