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Final Report: SIREV –  
Development of  
a Functional Model

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### Final Report: SIREV – Development of a Functional Model

In the framework of a contract set up by STN Atlas GmbH, Bremen, DLR has developed the Sector Imaging Radar for Enhanced Vision (SIREV) together with IHE Karlsruhe, and AeroSensing as subcontractors. A functional model of a forward looking radar system has been developed, including the hardware setup in a DLR helicopter and the software for data processing. The outstanding performance of the demonstrated system makes it a basis for further developments regarding flight collision avoidance or landing aid systems.

This final project report gives an overview about the project goals. The system specification including the radar hardware, antenna module and instrument parameters are presented. The data processing was performed by the Extended Chirp Scaling Algorithm for SIREV. The images, processed from raw data acquired during test flights of the SIREV system, are presented and analyzed in terms of imaging performance. Additionally some postprocessing procedures have been developed for further improvement of the image quality.

### Endbericht: SIREV – Entwicklung eines Funktionsmodells

Im Rahmen eines Vertrages mit STN Atlas GmbH, Bremen, hat das DLR das "Sector Imaging Radar for Enhanced Vision" (SIREV) System zusammen mit IHE Karlsruhe und AeroSensing als Projektpartner entwickelt. Die Entwicklung eines Funktionsmodells für ein vorausschauendes Radarsystem einschließlich der Integration der Hardware in einen DLR Hubschrauber und die Entwicklung geeigneter Algorithmen und Software für die Prozessierung wurde durchgeführt. Die hervorragende Leistungsfähigkeit dieses Systems prädestiniert es als Grundlage für Flug-Kollisions-Warn- oder Landungshilfe-Systeme.

Dieser Endbericht stellt zunächst die Projektziele dar. Danach werden die Systemspezifikation, die Radar-Hardware, die SIREV-Antenne und die grundlegenden Systemparameter behandelt. Die Prozessierung der Daten erfolgt mit dem hierfür weiterentwickelten Extended Chirp Scaling Verfahren für SIREV. Die Radardaten der Flugexperimente werden verarbeitet, dargestellt und analysiert. Schließlich wird eine Nachbearbeitung zur weiteren Verbesserung der Bildqualität vorgestellt.

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# 1 Introduction and Summary

## 1.1 *SIREV* Project Goals

On 25. January 1999 a contract between the Deutsches Zentrum für Luft- und Raumfahrt e.V. and the STN ATLAS Elektronik GmbH was signed to establish a collaboration in the field of the *SIREV* (Sector Imaging Radar for Enhanced Vision) technology. STN ATLAS and DLR agreed to schedule the time of development for the *SIREV*-system by at least three years.

The entire project is to be carried out in three phases. The goal of phase 1 of this project is the development and the testing of a functional hardware model to demonstrate the *SIREV* principle for applications of STN ATLAS. After verification of function it is the aim to develop a prototype in the second phase. The third phase ends with the development of *SIREV* to production stage.

Within phase 1 it was not only intended to prove the mere verification of function, but also to achieve the prognosticated quality of visualisation of radar data in flight direction. Simulations of SAR-data were taken as a basis and compared to the processed flight data in three different frequencies. Simulations were carried out by X-, Ka- and W-band.

According to the contract a work break down structure (WBS) was established showing the contributions to this project to be accomplished by all the individual partners. Due to the project development the WBS shown in is slightly modified compared to the chart included in the contract. The original WBS was adopted to the actual insights and inherent necessities. Therefore some new tasks were initiated, some other tasks were modified. All changes are marked in blue in Figure 1.

This final report is structured according to the WBS depicted in. The main headlines of all chapters are according to the WBS.

### 1.2 SIREV Partner

A joint project team of STN ATLAS and DLR was installed for the development of SIREV. The tasks of the project team contained primarily:

- the commercial and technical coordination
- the acquisition of advancements
- the technical development and test of the functional model

The project management of phase 1 was in the hands of the Programmleitung Luftfahrt, Abteilung Luftfahrtprojekte. STN ATLAS accompanied the project in this phase on an administrative and technical-scientific basis. During the first six months this was carried out by the company Pietsch NT, Karlsruhe, in the second half of the year by STN ATLAS, Bremen themselves.

The scientific technical coordination of the SIREV functional model as well as the required development of data processing software were carried out by the Institut für Hochfrequenztechnik und Radarsysteme.

The development of hardware was in the hands of AeroSensing, Oberpfaffenhofen and the Institut für Höchstfrequenztechnik der Universität Karlsruhe. AeroSensing was responsible for the supply and adaptation of the radar system; the Institut für Höchstfrequenztechnik developed and built the antenna.

Flight tests were carried out by a helicopter (Bo 105) of the DLR Flugbetriebe.

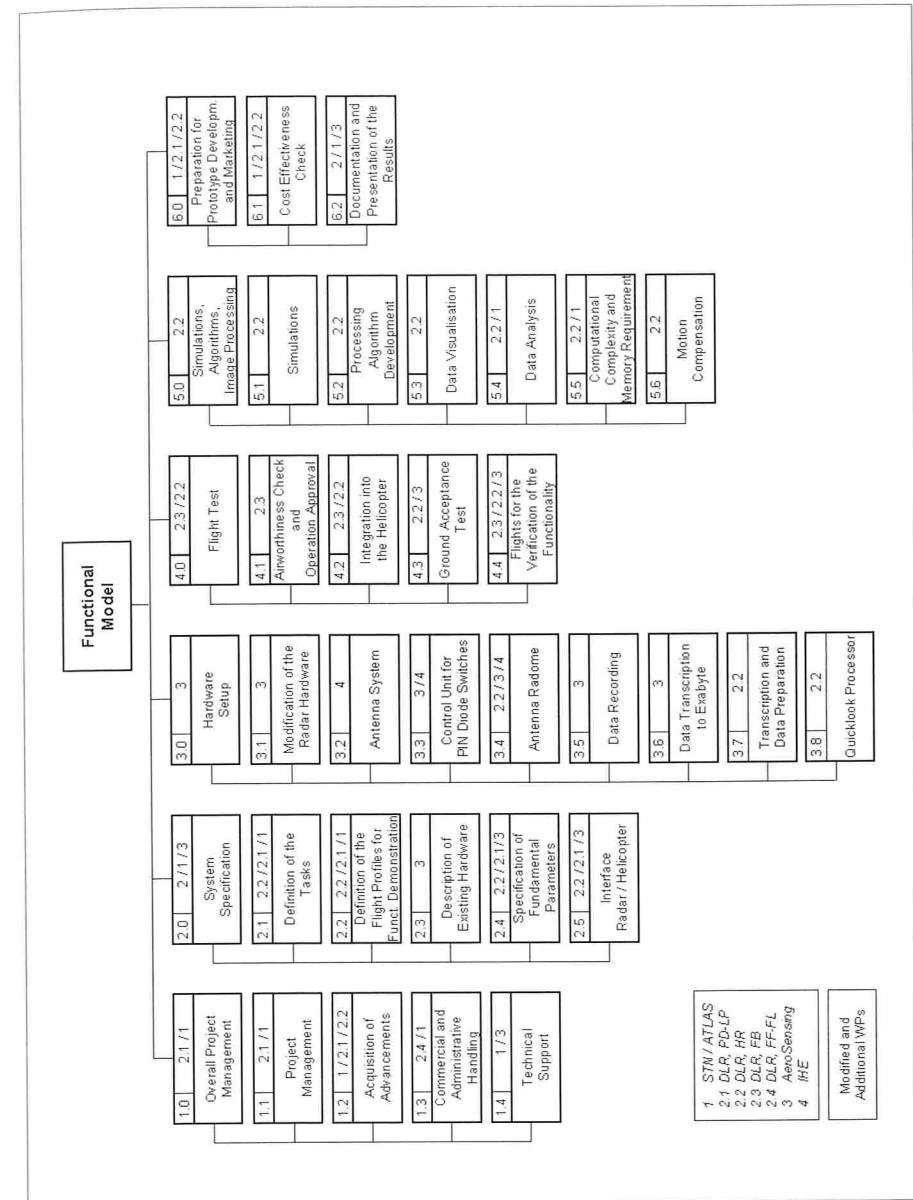


Figure 1: SIREV progress chart. The blocks shades in blue are additional or modified work packages.