

New Gyroplane Development in South Africa

A BRIEF OVERVIEW

Text and photography by Philip Nell

During the past four-and-a-half years, I have been deeply involved with the development of a proudly South African Gyroplane called the 'Kriek'. This article provides a short overview of the progress to date and plans for the future.

While investigating the possible usage of Gyroplanes for Military applications, I met Johan Von Ludwig, a Chemical Engineer by profession, but a true Gyroplane aviator by heart. Two weeks later my amazing journey started with a simple handshake. The deal was that I would assist Johan with the development and Airworthiness qualification of a new Gyroplane.

By that time, Johan had designed, constructed and flown his own design tail dragger Gyroplane called the 'Springkaan' with a 300 hp Toyota Supra engine and locally developed 33' composite rotor blades. This was a pure 'technology demonstrator' to prove the various concepts. The initial plan was to industrialise the design and then market it as a 'flying one ton bakkie'. This prompted the need for CAD and Production specialists resulting in Christie Kuys and Jan Rossouw, both Mechanical Engineers, joining the development effort.

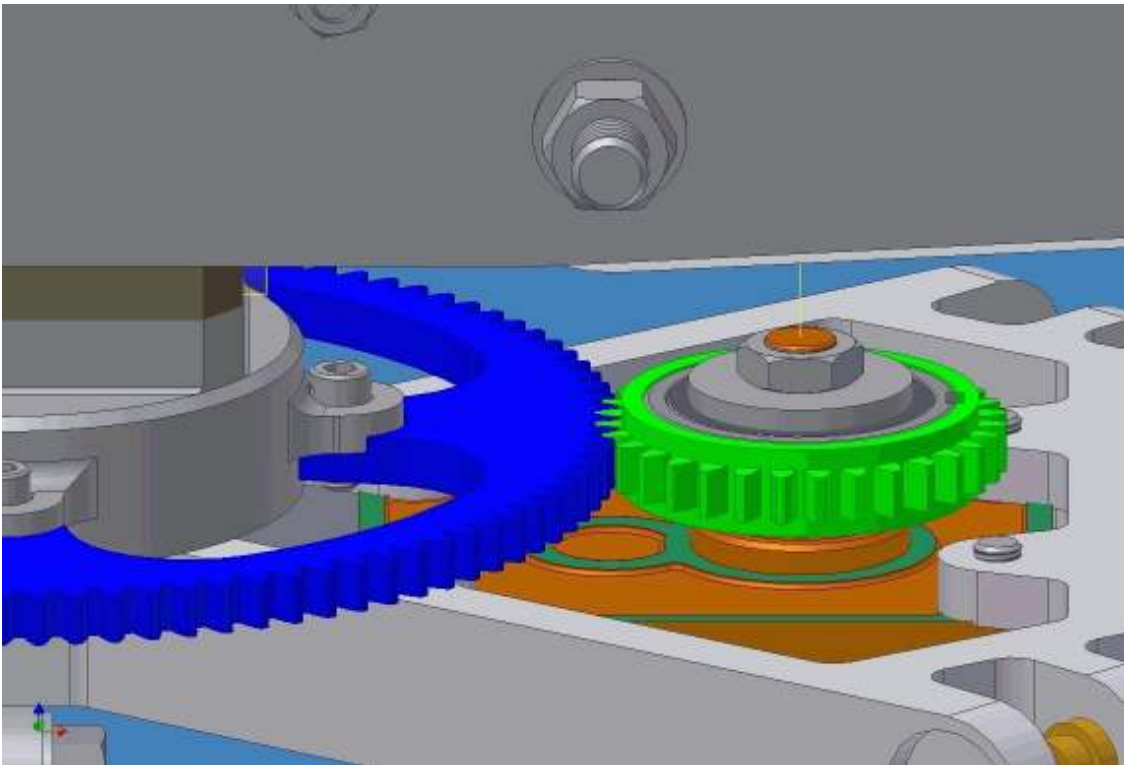


Springkaan technology demonstrator

The rotor head was the first area of focus, and a unique mechanism was added to the cheek plate's design to finely adjust the pitch of both blades for accurate tracking and thus low vibrations. To date, the rotor head has undergone a total of 5 updates, with more than a thousand five hundred flying hours without a single failure. It, together with the blades, have also been structurally tested to 20 tons in the horizontal and 10 tons in the vertical axis. This is also the area where the most optimization for a specific airframe can be done, as there exists a fine balance between the coning angle, under sling and blade pitch for increased efficiency and reduced vibration levels.



Rotor head with adjustable pitch mechanism and hydraulic motor



Rotor head CAD model with one-way bearing

Another lengthy, but in the end very worthwhile development was the hydraulic prerotator system. A modified hydraulic pump is driven from the propeller hub with a toothed belt and electromagnetic clutch. This in turn drives a rotor head-mounted motor driving a sprocket gear via a one-way bearing. This eliminates the requirement for a Bendix gear and ensures a smooth start, reducing the torque impulse on the rotor mast. In addition, the rotor can be tilted fully back during the spin-up process to decrease the take off distance.



Hydraulic pump and clutch fitted to a Rotax 914

To reduce the developmental risks, all the new systems were extensively tested on ELA 08 and Magni Gyroplanes, and proved to be the correct approach.

Early on in the design of the updated Springkaan, calculations indicated that the 33' rotor system was not long enough to provide adequate lift for the planned > 1 ton MAUW. The design was therefore re-directed to use a modified Bush Baby frame and fit the proven rotor system to it, hence the birth of the Kriek MK1 which first flew during October of 2005. Excessive vibrations ruined any further flight tests, and it took many months to figure out what the root cause was. It turned out that the rotor mast stiffness and natural resonance frequencies are critical for any Gyroplane design. This resulted in the complete re-design of the frame and mast, using my 6'4" stature as maximum percentile for the cockpit anthropometric dimensions.



MK1 ready to fly

The new Kriek MK11A first flew successfully during February this year in a tail-dragger configuration, which was chosen for improved take off performance. Numerous flight tests however confirmed that it had a tendency to yaw at the point of take off and when landing with the tail wheel first. An unanimous decision was thus taken to convert the Kriek to a conventional tricycle configuration with steer able nose wheel. This MKIIB configuration flew successfully on the 20th of May and confirmed the exceptional stability of the tractor configuration.



Johan ready for first flight of MKIIA



After successful first flight



Kriek MKIIB with new tricycle undercarriage



Latest model Kriek

In parallel with all the above developments, the first 250 mm cord, locally extruded aluminium rotor blades are ready to be test flown. This should provide up to a 37' rotor system, suitable for the Springkaan and other larger Gyroplanes. The engine-of-choice for the 680 kg MAUW of the Kriek is the Subaru 2.5 L, and development of a dual-redundant ignition and fuel injection systems are in an advanced stage.



New 250 mm rotor blades compared to existing 220 mm units

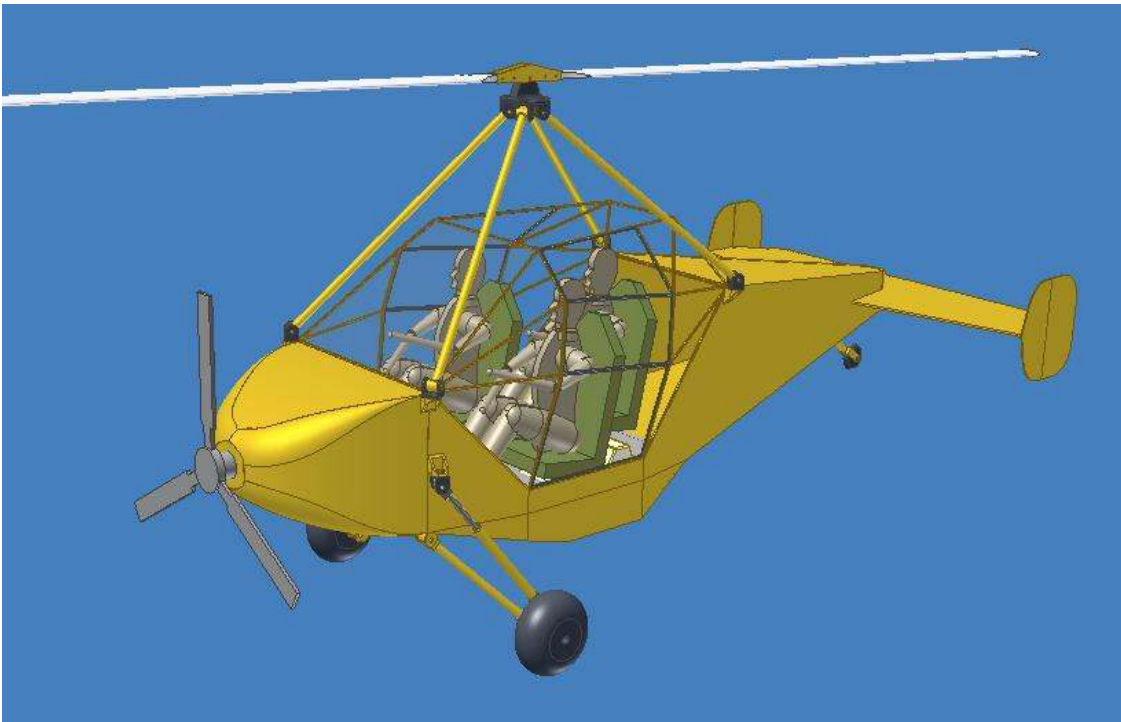


Subaru with custom reduction gearbox



Subaru test stand with water dyno attached

The production of the Kriek is planned for the end of the year with the development of the 3-seater Springkaan and a single seater 'Mozzie' to follow shortly there after. We are also in process with writing 'The Gyroplane Design Handbook' to document all our experience and provide design guidelines for future Gyroplane designers.



Springkaan 3-seater CAD model



Mozzie single seater

Please visit www.wagtail.co.za for more information.