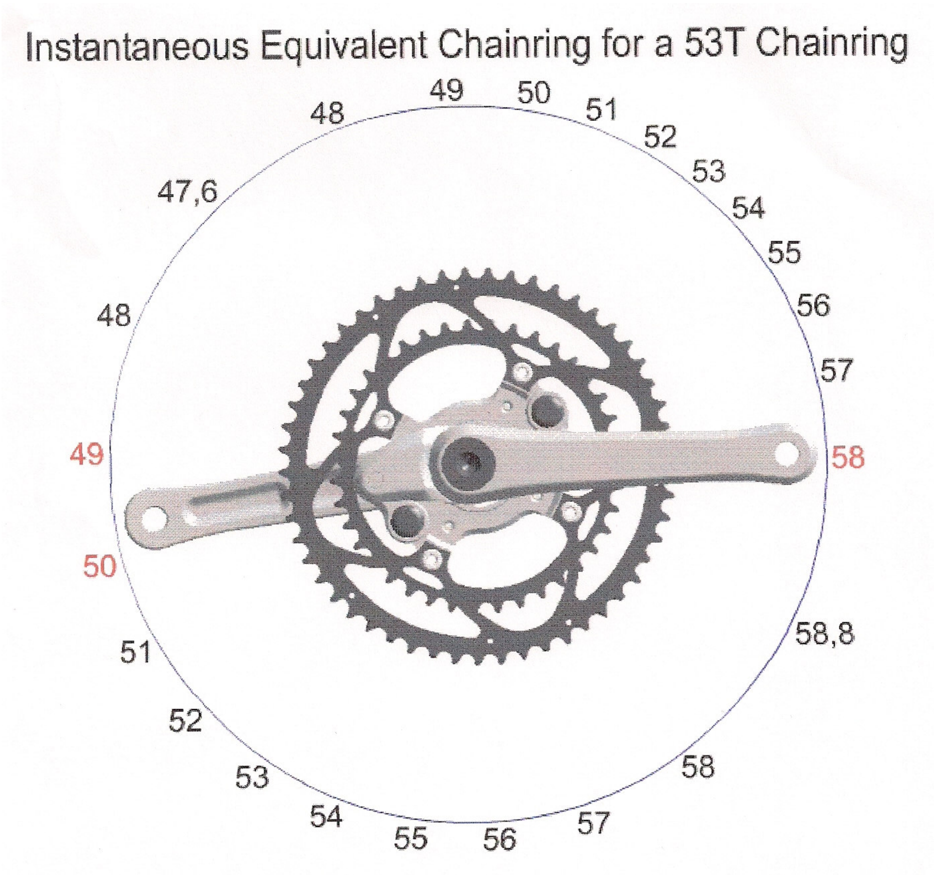
Project 001: Comparative biomechanical study of Rotor System Crank

The comparative biomechanical study of a circular chainring and the Rotor System Crank (RSC) for endurance cycling at constant speed was executed, based on the "virtual non-circular chainring" (instantaneous equivalent chainring for a 53-teeth circular chainring) of the Rotor System Crank.



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First of all, we tested the RSC with the crank arm positioned versus the major axis of the “virtual non-circular”, as it has been designed by Rotor (62°).
In a second test, we re-oriented the crank arm versus the major axis of the “virtual non-circular” to the “optimal” position (106.7°).

Test results Rotor System Crank

Rotor System Crank	Ratio Major versus Minor Axis	Angle Major axis versus Crank	Peak Knee Power extensors for same given Crank power % difference vs Circular	Crank Power for same given Joint Moments % difference vs Circular
Rotor Original	1.235	62°	-3.0 %	+2.2 %
Rotor Optimal	1.235	106.7°	-7.5 %	+2.2 %

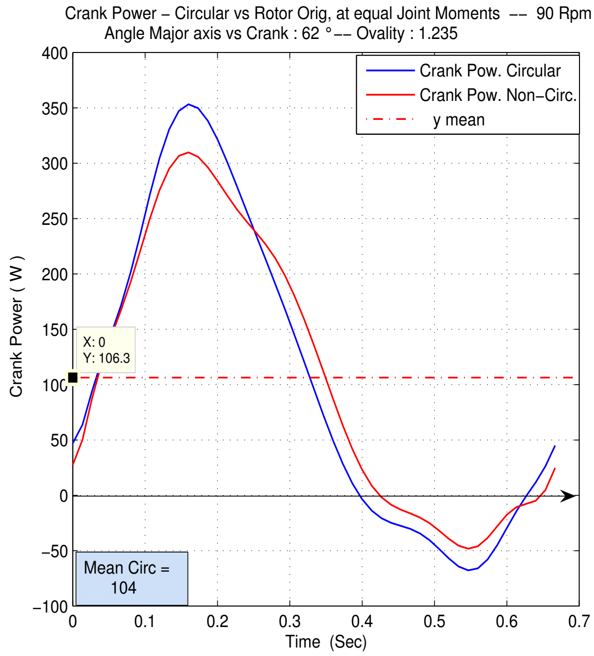
Re-orientation of **crank arm** versus the “virtual major axis” of RSC.

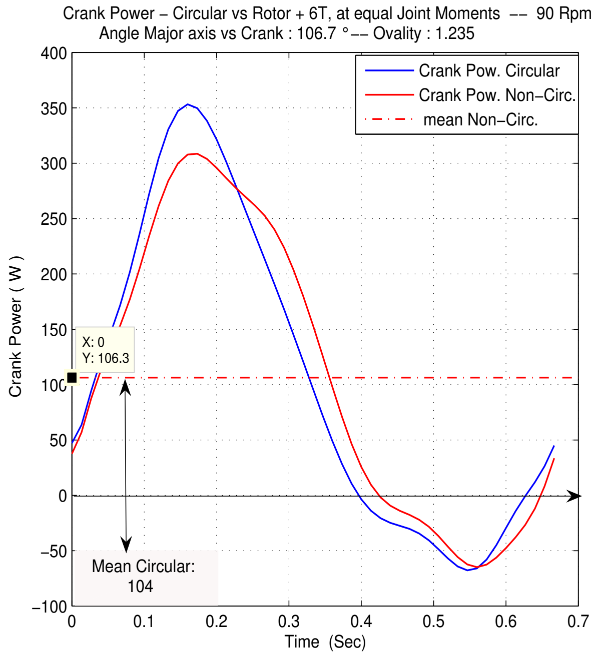
	62°	-3.0 %	+2.2 %
	76.9°	-4.5 %	+2.1 %
	91.8°	-6.0 %	+2.0 %
	106.7°	-7.5 %	+2.2 %

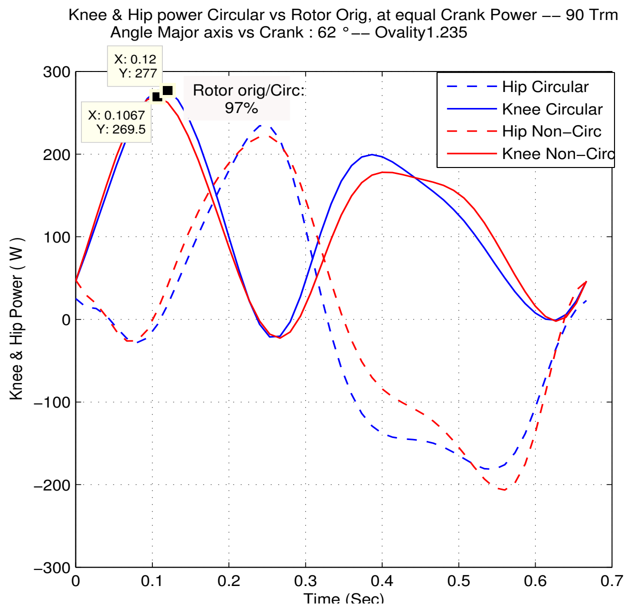
Graphs

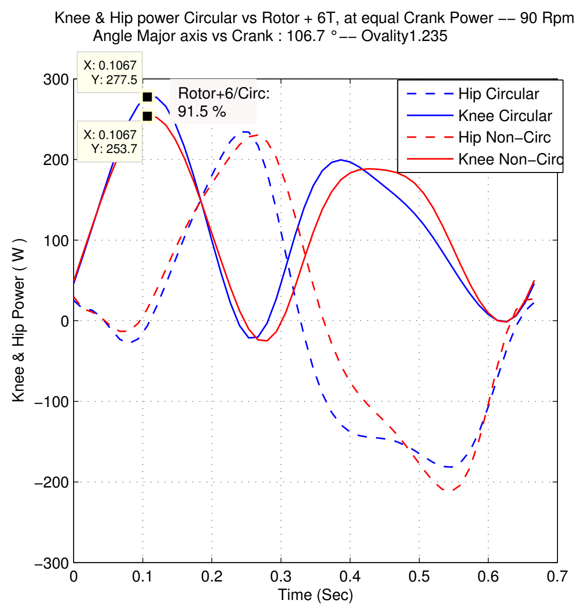
Rotor Original 62°

Rotor Optimal 106.7°









Some observations:

The ovality (major axis versus minor) of the “virtual non-circular chainring” of the RSC is 23.53% (see picture Instantaneous Equivalent Chainring). This is completely in line with the findings out of our comparative biomechanical study: a minimum ovality is needed to be able to yield attractive power efficiency rates.

The Rotor System Crank shows attractive performance indices compared to a circular chainring.
Re-orienting the crank arm from the “original” to the “optimal” crank angle versus the “virtual major axis” does not change the power output but improves significantly the peak load on the knee extensor muscles and keeps acceptable peak loads on the knee flexors and on the hip joint muscles.

Performances of the Rotor System Crank (“optimal”) are roughly comparable with the best non-circular chainrings in our study although slightly weaker in terms of crank power efficiency gain.

An **important difference** between a non-circular chainring and the Rotor System Crank is a.o. that during one complete pedal revolution, for the RSC, there is only one deceleration phase and only one acceleration phase, whereas for a non-circular chainring there are two decelerations and two accelerations. This means that the ovality of the RSC is spread over a full 360° cycle which explains most probably the power being constant over an extended crank angle range.

The **Rotor System Crank** is a **brilliant** example of inspired engineering, excellent design and high standard manufacturing workmanship, and is also, to the authors opinion, a biomechanical (-dynamical) cycling solution that works.