BIOMECHANICAL PERFORMANCE DIAGNOSIS IN CYCLING
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Introduction
Biomechanical performance diagnosis in cycling is relevant for both performance enhancement and rehabilitation aspects. Elite cyclists seek to optimize force transmission to minimize their effort for a given power-output. This is a question of pedalling technique or mechanical economy. After injuries or when problems occur with the musculoskeletal system during or after cycling it might be necessary to get complex but concise information about the cycling or pedalling movement, forces, moments and muscular activity pattern. This information has to be available directly after or even simultaneously to the measurement.

Pedal-Forces
Pedal-force measuring devices exist for several years now. As recently as new systems allow to use the cyclist’s own pedals to measure crank-torque or pedal-forces (1) pedal-force measurements found their way into performance diagnosis. Together with a special automatic data acquisition and analysis software athletes get a direct feedback about their loading pattern. On the one hand this technology was used to test the possibility of changing the pedalling technique by application of force-feedback during the training process. Statistically significant changes in the force application pattern could be reported after 12 training sessions with force feedback. On the other hand anomalies in the characteristics of the force/crank-angle diagram serve to uncover mechanical problems or coordinative dysfunctions and help in the process of therapy.

Muscular Activity Pattern (EMG)
With the same technique of automatic data acquisition EMG-recordings could directly be summed up (ensemble average) and circularly displayed while the cyclist is riding on the ergometer. Again, the potential for online-feedback to intervene in the process of technique-training or for individual performance diagnosis occurs from this. Bio-feedback might be topic of future studies especially with handicapped athletes e.g. with lower leg dysfunctions. Regarding the optimization process of elite athletes – e.g. evaluation of different seat positions in single case analysis – the circular EMG/crank-angle diagram helps to interpret the activity and functional role of each recorded muscle.

Kinematics
A further step in getting information about the interaction of athlete and bicycle is the calculation of joint reaction forces and joint moments. The reported pedal-force measuring device and digital video technique supplied the input for an inverse dynamic rigid body’s model which could be used for optimization processes (2).

References

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