Project: MMSS54

Module: Anti-jerking function

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change documentation

Version: 1.0 02.11.2004

initial creation

8th anti-jerking function AR

8.1 General

During a rapid transition from overrun or low partial load to higher load ranges, vibrations can occur in the drive train in the lower speed range. The anti-jerking function of the MSS54 counteracts these jerking vibrations by detecting the vibrations of the drive train and dampening them by applying torque in the correct phase.

During a positive speed gradient (increasing engine speed), the delivered engine torque is reduced by means of a torque intervention (ignition angle retardation).

8.2 Calculation of speed gradients for AR

The calculation of the speed gradient "d_n_segment" is based on the segment speed "n_segment" and is repeated every 120°CA. The segment speed is calculated from the duration of a segment (60°CA before TDC to 60°CA after TDC).

Calculation formula:

d_n_segment(t)= ((n_segment(t) - n_segment(t-120°) / t_segment(t) + d_n_segment(t-120°)) / 2

Speed gradient = Average value of the speed difference between two segments, normalized to rpm/sec and the previous gradient

8.3 Activation condition of the AR

To activate the anti-jerking function, the following conditions must be met:

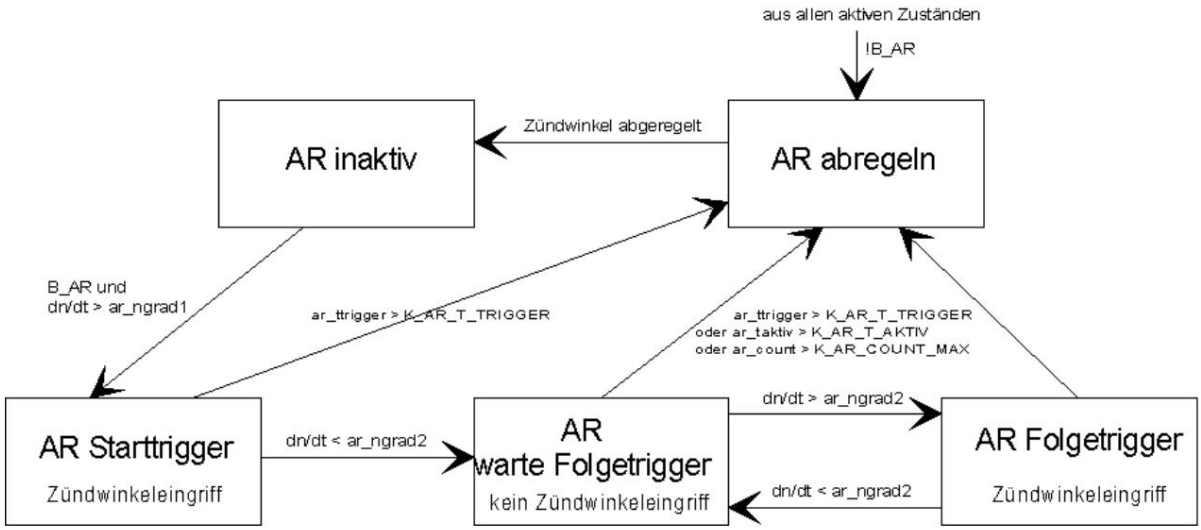
```
B_AR =      B_TL                                ; partial load operating state
        and tmot ÿ K_AR_TMOT_MIN and            ; Engine temperature greater than threshold
        K_AR_NMIN ÿ n ÿ K_AR_NMAX and           ; Speed within range
        K_AR_RFMIN ÿ tl ÿ K_AR_RFMAX ; load within range
        and     ( K_AR_VMIN ÿ v ÿ K_AR_VMAX or  ; Speed within range
                  B_V_FAILURE ) and             ; as long as V-detection is error-free
        S_GANG                                  ; traction present
                                                ; ( not active at the moment )
```

For the following documentation, the activation condition is summarized as the condition B_AR.

B_AR = 1 : condition fulfilled
B_AR = 0 : condition not met

8.4 States of the AR

Figure 8.1: State machine of the anti-jerking function



As long as the condition B_AR is not fulfilled and the ignition angle interventions of previous AR controls have been regulated, the AR is in the "inactive" state.

If the condition B_AR is fulfilled, the AR changes to the "start trigger" state as soon as a speed gradient greater than the trigger threshold ar_ngrad1 (from map KF_AR_NGRAD1 = f(n, tl)) is detected.

If the speed gradient falls below the value ar_ngrad2 (from map KF_AR_NGRAD2 = f(nt, tl)), the AR changes to the "wait for follow-up trigger" state. If this gradient threshold is not undercut within the time K_AR_T_TRIGGER after the start trigger is detected, it is concluded that there is no jerking oscillation and the AR changes to the "regulate down" state.

In the "Waiting for follow-up triggering" state, no AR ignition angle intervention is active. As soon as the speed gradient exceeds the threshold ar_ngrad2 again, the AR changes to the "follow-up triggering" state. If this threshold has not yet been reached, the AR changes to the "regulating down" state as soon as one of the following conditions is detected.

- Time since last state transition > K_AR_T_TRIGGER
- Total time of AR active • Number of triggers > K_AR_T_AKTIV > K_AR_COUNT_MAX

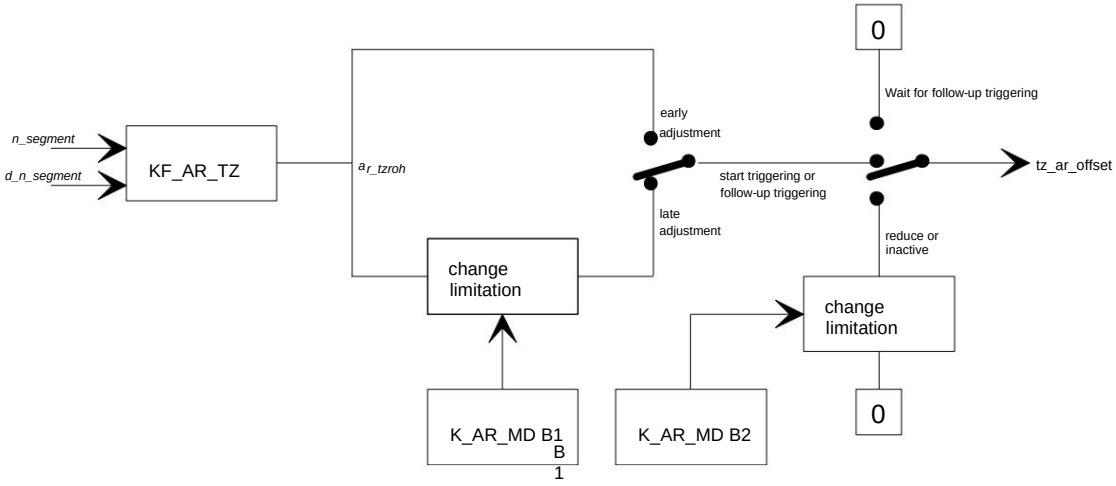
In the "follow-up triggering" state, an ignition angle intervention is again active. A change to the "waiting for follow-up triggering" state occurs when the speed gradient becomes smaller than ar_ngrad2 again and the conditions for ending the AR have not yet been met.

In the "regulate" state, the AR should be terminated. Any existing ignition angle interventions are regulated off. The system then switches to the "inactive" state.

The following applies to all active states: As soon as the condition B_AR is no longer fulfilled, a change to the "regulate down" state occurs.

8.5 Ignition angle intervention of the AR

Figure 8.2: Calculation of the ignition angle offset



8.6 AR data

Variable of AR:

name	Importance	Type	Resolution
ar_mdroh	of unfiltered torque offset of the AR	sw	1/10 °KW
ar_grad1	Gradient threshold for AR triggering sw 1 rpm/s		
ar_grad2	Gradient threshold for AR follow-up triggering sw 1 rpm/s		
ar_taktiv	System time at which AR was last activated uw 1 ms		
ar_ttrigger	System time at last AR triggering uw 1 ms		
ar_count	Number of triggers uc 1		
ar_status	State variable of the AR (only 1 bit set at a time) Bit 0: AR inactive 1: Start trigger detected 2: wait for follow-up triggering 3: Follow-up trigger detected 4: Reduce AR interventions	uc	
ar_md_offset	ignition angle offset of the AR	sw	1/10 °KW

AR application data:

name	Meaning
K_AR_TMOT_MIN	lower temperature threshold for AR
K_AR_NMIN	lower speed threshold for AR
K_AR_NMAX	upper speed threshold for AR
K_AR_RFMIN	lower filling threshold for AR
K_AR_RFMAX	upper filling threshold for AR
K_AR_VMIN	lower speed threshold for AR
K_AR_VMAX	upper speed threshold for AR
K_AR_T_TRIGGER	max. period for the next triggering
K_AR_T_AKTIV	max. active time of the AR
K_AR_ANZ_TRIGGER max. number of triggers	
K_AR_MDB1 Ignition angle change limitation for AR retardation	
K_AR_MDB2 Ignition angle change limitation for AR reduction (early)	
KF_AR_NGRAD1 Graduation threshold for start triggering = f(n,rf)	
KF_AR_NGRAD2 Graduation threshold for follow-up triggering = f(n,rf)	
KF_AR_MD Ignition angle offset of the AR = f (n,dn/dt)	