

UNIVERSITI TEKNOLOGI MARA

**THREE-TERM CONJUGATE
GRADIENT METHOD FOR
REDUCING MOTION BLUR IN
VIRTUAL REALITY**

**AINUR MADIHAH BINTI MOHD
NORDIN**

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ABSTRACT

Optimization plays a critical role in solving complex mathematical and real-world problems by identifying the best possible solutions. The efficient optimization methods are essential for improving performance, accuracy, and resource management. Among various optimization methods, the conjugate gradient (CG) method is widely used and has been applied in many applications such as signal recovery, robotic motion, and virtual reality (VR). One major challenge in virtual reality (VR) applications is motion blur, which reduces image clarity, negatively impacts user immersion, and may cause discomfort. Thus, this research applies a three-term conjugate gradient (TTCG) method as an optimization method to improve image sharpness in VR applications. The objective of this research is to evaluate four TTCG methods, TTRMIL, TTAMRI, TTLAMR, and TTSMAR, using fifteen standard unconstrained optimization test functions. Each method is assessed based on computational efficiency, measured by the number of iterations (NOI) and CPU time, under exact line search. Among the tested methods, TTRMIL appears as the most efficient, with a successful percentage of 99.64%, followed by TTLAMR (98.93%), TTSMAR (98.57%), and TTAMRI (97.50%). TTRMIL is applied to a motion deblurring problem using a blurred image as a test case. As conclusion, the TTCG method is effective in solving large-scale optimization problems and can be applied in real-time image processing for virtual reality environment.

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