# ANALISIS SIMULASI *EXTENDED KALMAN FILTER* (EKF) UNTUK *ACTIVE NOISE CONTROL* (ANC)

SKRIPSI

Diajukan untuk memenuhi sebagian dari persyaratan dalam memperoleh gelar
Sarjana Teknik pada Program Studi Sistem Telekomunikasi
Universitas Pendidikan Indonesia

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**UNIVERSITAS PENDIDIKAN INDONESIA**
**2025**

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Sebuah skripsi yang diajukan untuk memenuhi salah satu syarat memperoleh gelar Sarjana Teknik pada Program Studi Sistem Telekomunikasi

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# ABSTRAK

Kebisingan frekuensi rendah merupakan tantangan dalam lingkungan industri karena sulit diredam dengan metode pasif. *Active Noise Control* (ANC) menjadi solusi efektif melalui pembangkitan sinyal *anti-noise* secara adaptif. Namun, efektivitas ANC sangat bergantung pada algoritma estimasi yang digunakan, terutama dalam kondisi kanal akustik yang nonlinier dan *time-varying*. Penelitian ini mengusulkan penerapan algoritma *Extended Kalman Filter* (EKF) dalam sistem ANC berbasis simulasi MATLAB: R2024a untuk mereduksi noise secara *real-time*. Kanal akustik dimodelkan menggunakan filter FIR orde 32 dengan variasi *time-varying* dan komponen nonlinier untuk merepresentasikan dinamika lingkungan nyata. *White noise* dan *pink noise* digunakan sebagai representasi gangguan *spektral* berbeda. Evaluasi performa dilakukan menggunakan parameter *Minimum Mean Square Error* (MMSE) dan *Signal-to-Noise Ratio* (SNR). Hasil menunjukkan bahwa EKF secara konsisten meningkatkan akurasi estimasi *noise* dan efektivitas peredaman dibandingkan baseline tanpa EKF, dengan nilai *gain* yang didapatkan sekitar 5-6dB. Selain itu, performa sistem lebih stabil terhadap *pink noise*, yang memiliki keteraturan *spektral*, dibandingkan *white noise* yang acak. Temuan ini menegaskan potensi EKF sebagai algoritma estimasi adaptif yang andal untuk sistem ANC dalam lingkungan akustik kompleks dan dinamis.
Kata Kunci: *Active Noise Control*, *Extended Kalman Filter*, MMSE, *pink noise*, *white noise*.

## *ABSTRACT*

*Low-frequency noise presents a significant challenge in industry environments due to its persistence and resistance to passive damping methods. Active Noise Control (ANC) offers an effective solution by generating anti-noise signals adaptively based on destructive interference. However, the effectiveness of ANC largely depends on the estimation algorithm employed, especially under nonlinear and time-varying acoustic channel conditions. This study proposes the implementation of the Extended Kalman Filter (EKF) in an ANC system using MATLAB: R2024a simulation to reduce noise in real time. The acoustic channel is modeled using a 32nd-order FIR filter with time-varying coefficients and nonlinear components to reflect real-world dynamics. White noise and pink noise are used to represent different spectral characteristics. System performance is evaluated using Minimum Mean Square Error (MMSE) and Signal-to-Noise Ratio (SNR) metrics. The results demonstrate that EKF consistently improves noise estimation accuracy and noise reduction performance compared to the baseline system without EKF, with a gain value obtained of about 5-6dB. Furthermore, the system shows greater stability when handling pink noise, which exhibits spectral regularity, compared to random white noise. These findings highlight the potential of EKF as a robust adaptive estimation algorithm for ANC systems operating in complex and dynamic acoustic environments.*


*Keywords: Active Noise Control, Extended Kalman Filter, MMSE, pink noise, white noise*

# DAFTAR ISI

# DAFTAR GAMBAR

# DAFTAR TABEL

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