Design and Digital Control of a Constant-Current LED Driver (Buck Converter)

間隔 (Duration): 4 Months (Independent study and design development alongside coursework)

チームの規模 (Team Size): Individual Project (1 Member)

私の役割 (My Role):

- Studied buck converter topology for LED current regulation
- Designed low-side current sensing using a shunt resistor
- Developed a digital PWM-based feedback control algorithm (Arduino-based)
- Analyzed how digital control affects regulation stability

目標 (Goal):

- To understand and design a closed-loop constant-current LED driver
- To analyze and understand control limitations relevant to practical LED power supplies

実装プロセス (Process Followed):

- Selected buck topology for step-down LED current control.
- Modeled LED current using shunt sensing (I = V/R)
- Implemented fixed-frequency PWM control

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実装プロセス (Process Followed):

- Designed discrete-time current adjustment using ADC feedback
- Evaluated stability and resolution limitations of digital control

達成事項 (Results):

- Goal achieved at conceptual and control-design level
- Developed a working closed-loop current regulation concept at the design level
- Identified practical engineering limitations

特定された制限 (Limitations Identified):

- 10-bit ADC resolution limits regulation precision
- Low switching frequency limits response speed
- Digital control introduces step-wise adjustment

今後の展望 (Future Development Scope):

- Hardware validation and PCB optimization
- Analog current-mode control design
- Higher switching frequency implementation

貢献の可能性 (Contribution Potential):

- Acquired Analytical foundation in LED current regulation
- Understanding of digital control limitations
- Motivated to refine design through OJT and practical hardware validation

ありがとうございます!!