Developing Real-Time Control For Electrospinning of Nanofibe

Measurements & Impact of Relative Humidity and Evaporation

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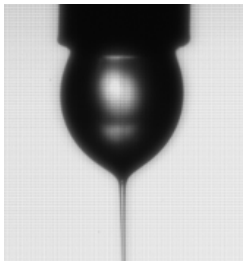

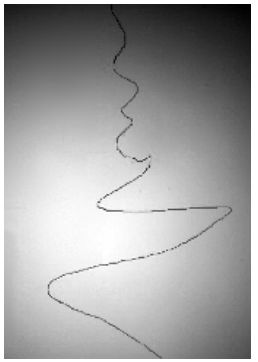

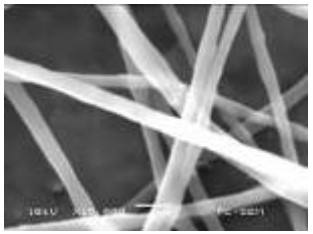

Review PEO/Water Results

- Measurements to predict fiber diameter
- Impact of humidity: Evaporation & Current

Extension to non-aqueous solvent: alcohol

- Evaporation Rates
- Fiber diameter relation to evaporation rate & D_{jet}
- Role of humidity
- Process dynamics for control

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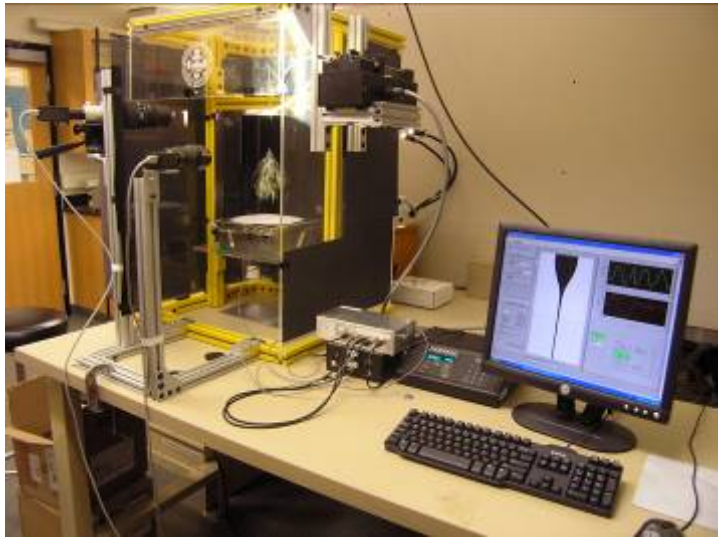
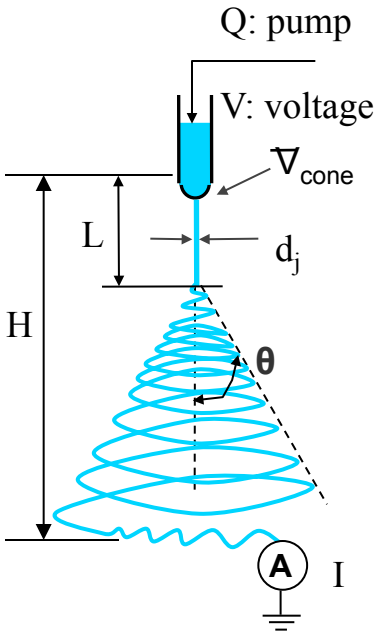
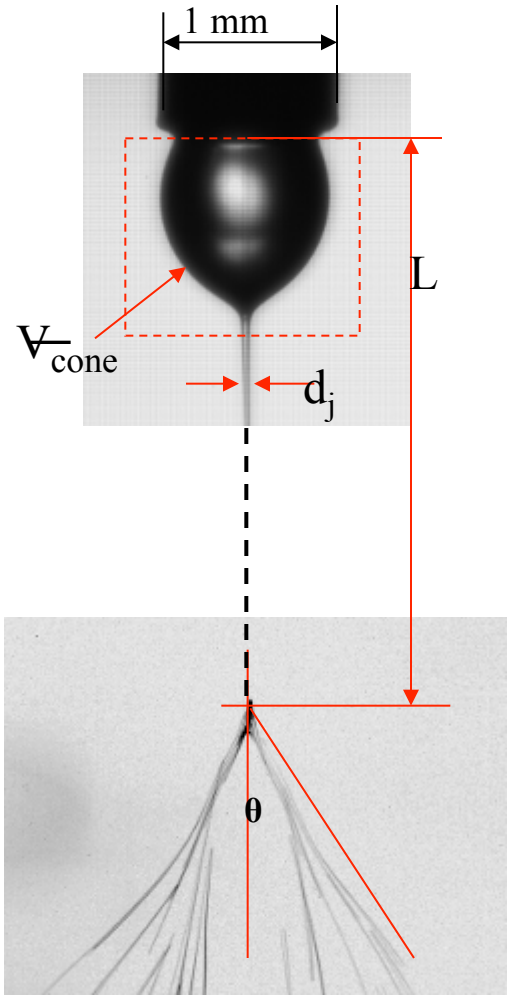
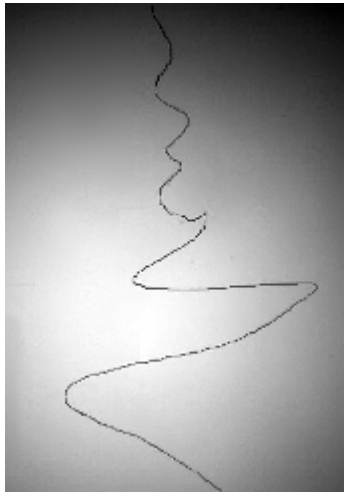
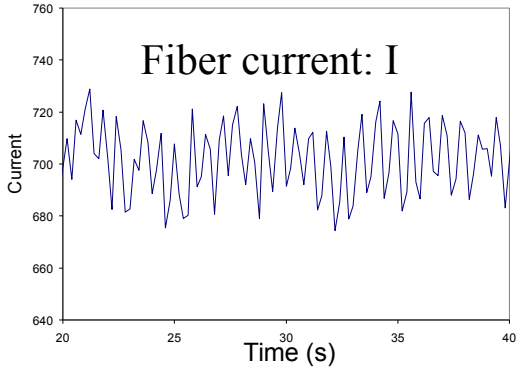
Development of the Measurement & Actuation System





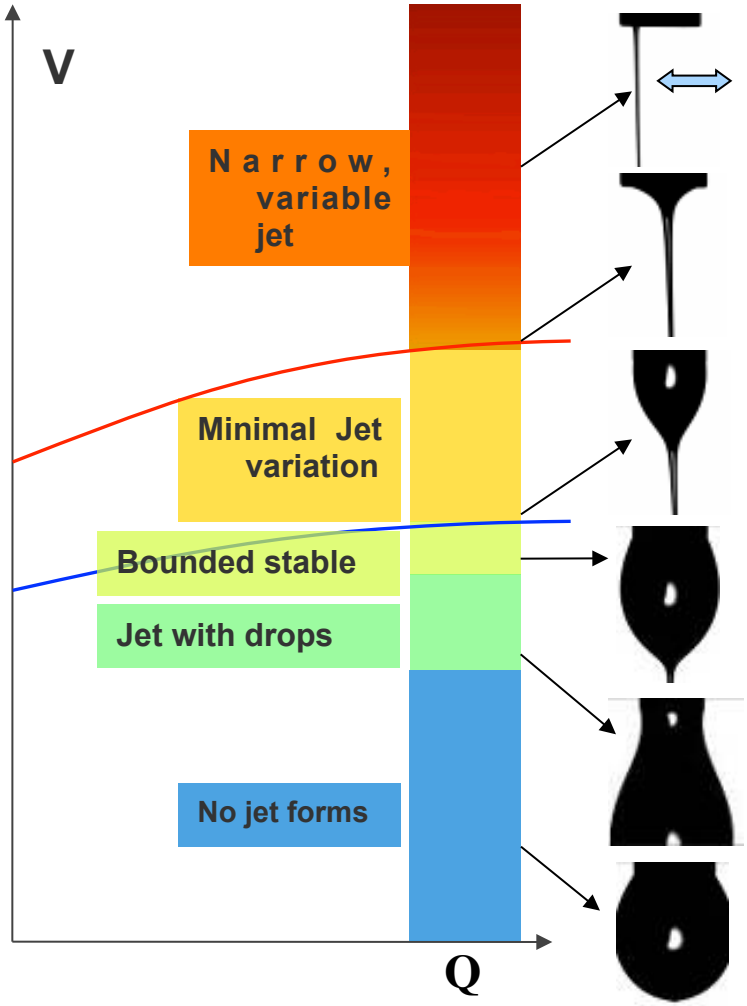




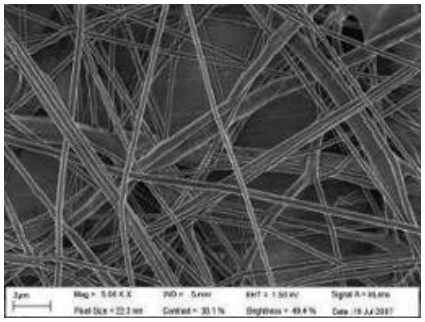


-Humidity: RH; -Temperature: T;

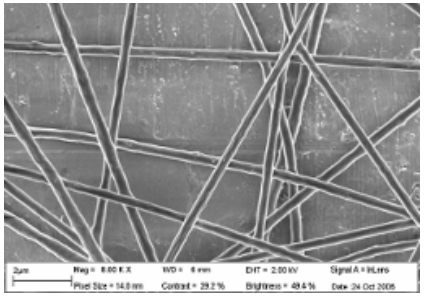
Operation regime determination for mapping process conditions



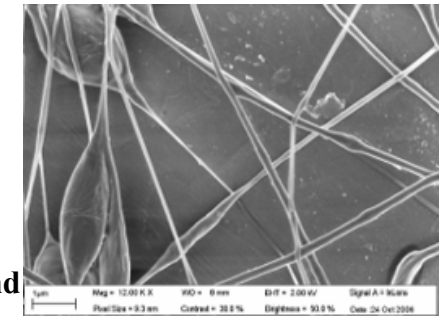
Electrospinning regimes identified by electric field strength and the corresponding Taylor cone shapes, 2M, 2.5%



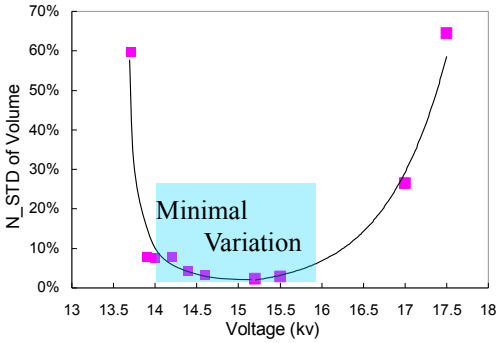
V=25kv



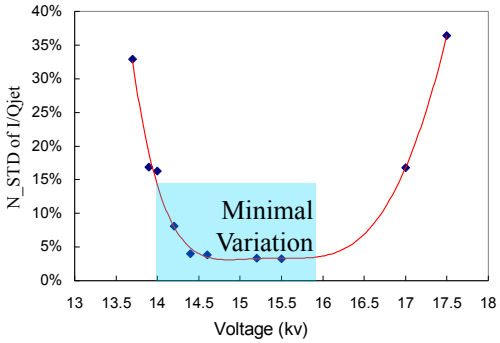
V=16.5kv



V=14.8kv



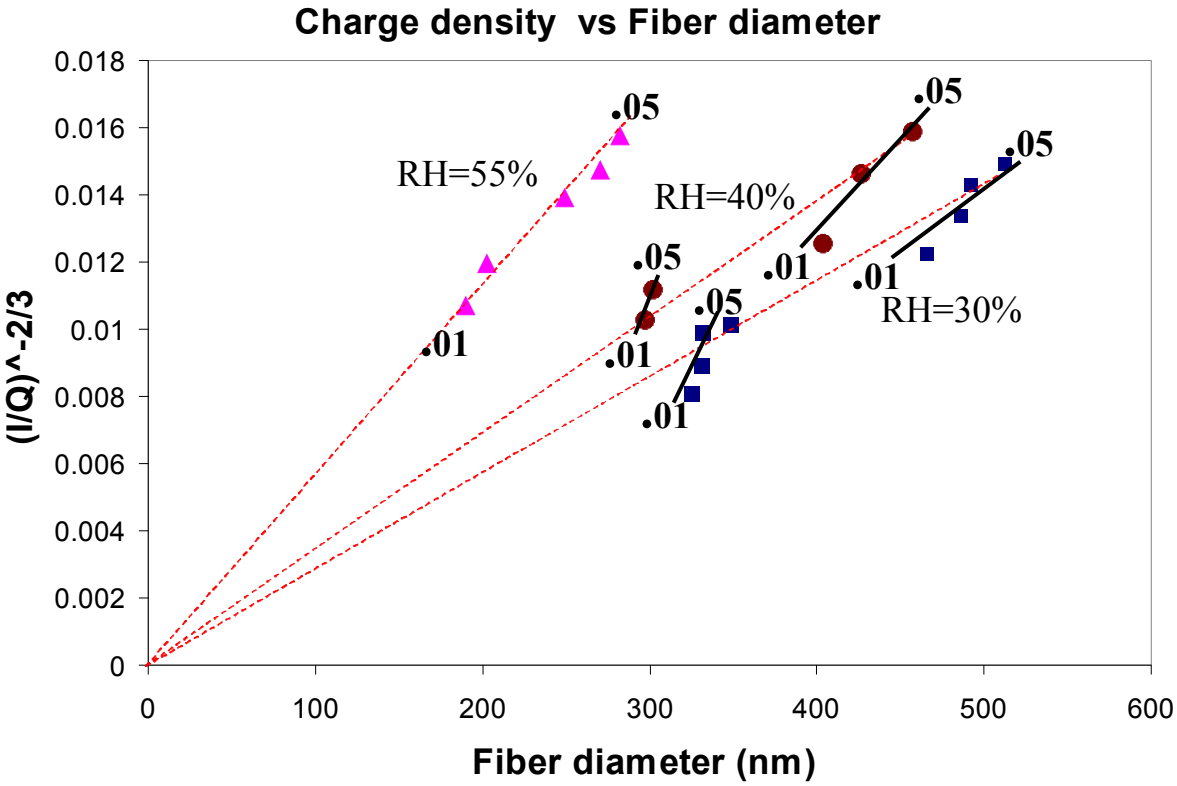
Volume variations
2.5%, Mw=2M, Q=0.01

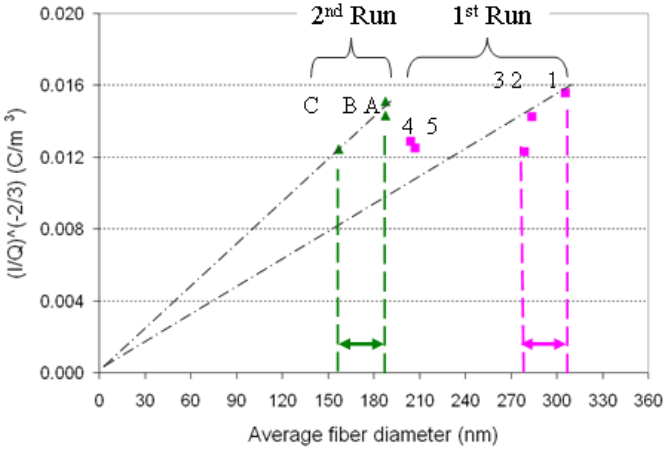


Charge density
2.5%, Mw=2M, Q=0.01

Effects of Humidity:
Fiber Diameter & Charge Density

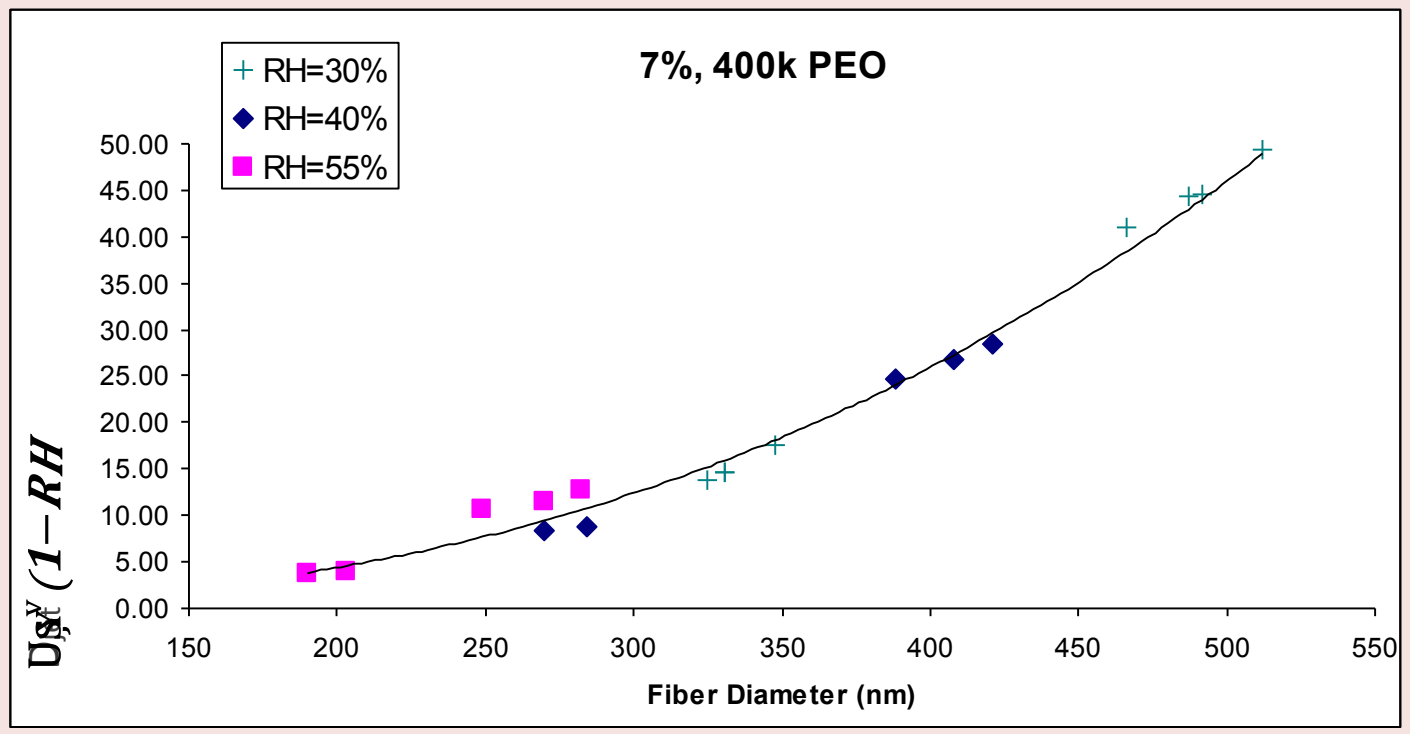
7wt% PEO in Water





Solvent evaporation rate (relative humidity, RH) causes the run to run variations
Evaporation rate (RH for water) is key factor for resulting fiber diameter
Charge density does not seem to provide global correlation

Jet Diameter/RH Correlation to Fiber Diameter



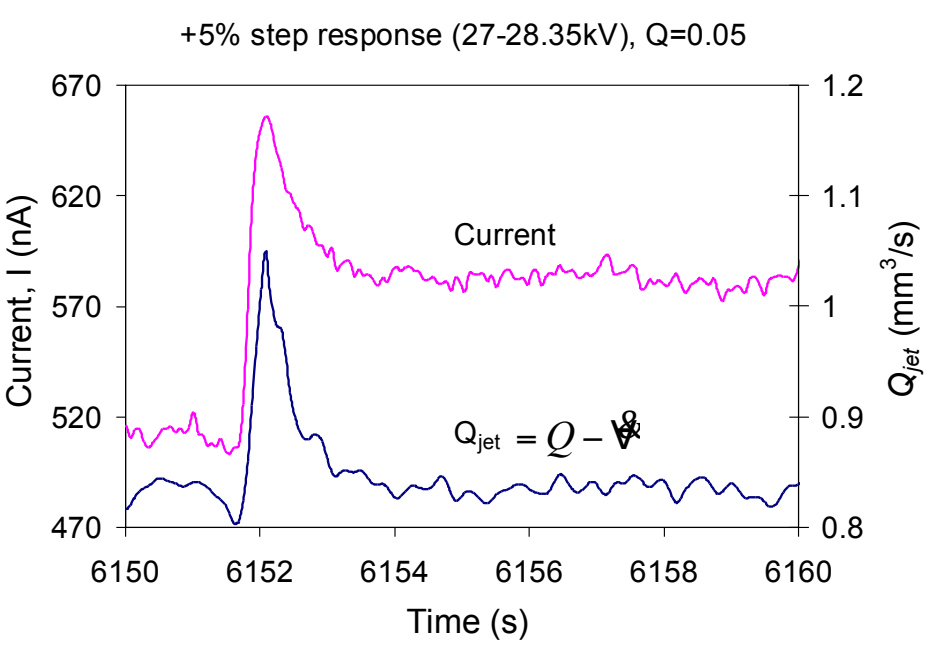
RH Impact

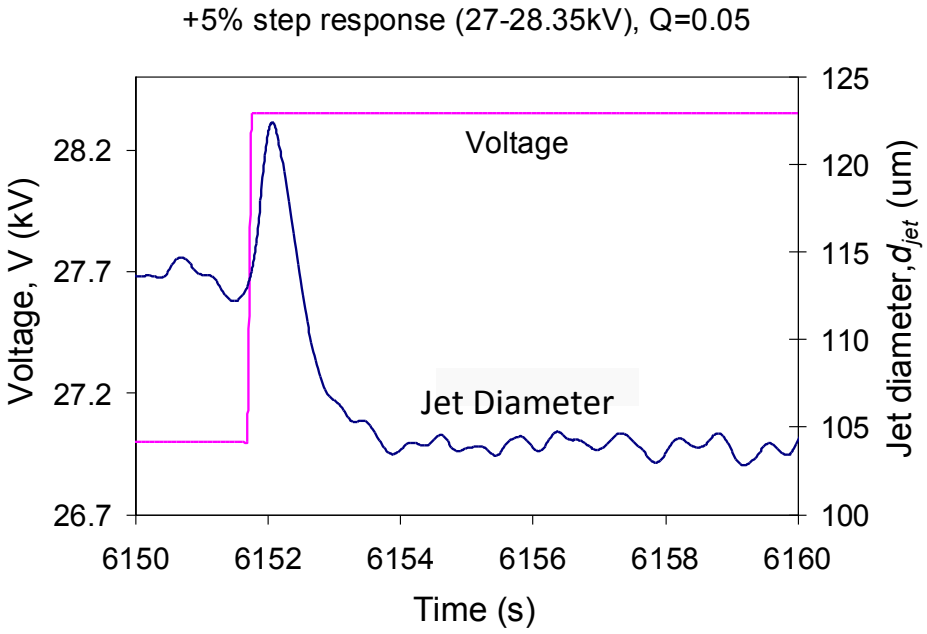
-Acts as disturbance: need control

-Use RH to achieve desired fiber diameter

-RH D_{fiber}

Dynamics of key process variables: PEO/Water

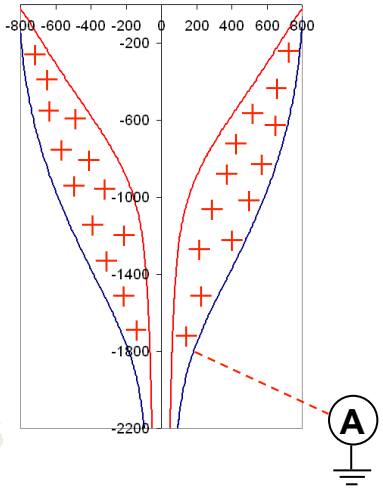


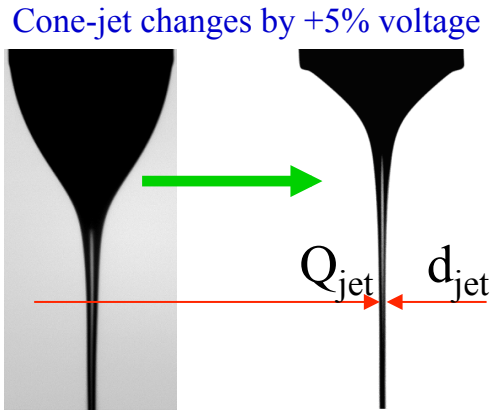


Extra volume forms Qjet spike, then back to steady-state Q;

Large overshoot in electric current from excess charges advected downstream

Right-half-plane (RHP) zero in jet diameter implicates control limitations





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