

Study on Self-excited Vibration of Wire Electrode in Wire-EDM

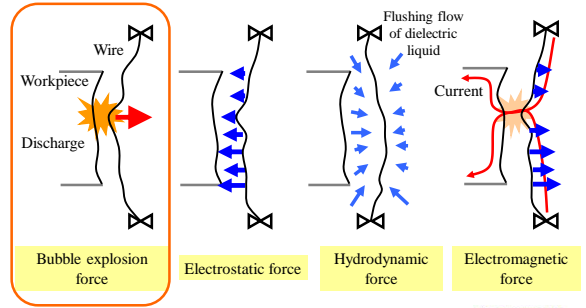
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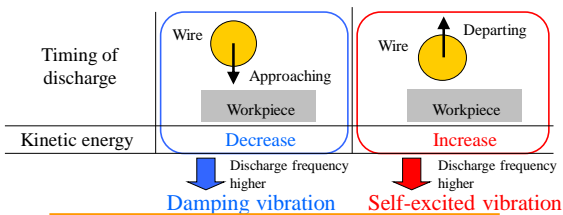
Introduction

Forces acting on the wire electrode



Introduction

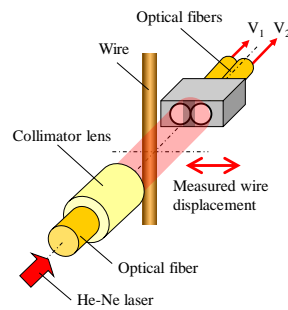
The wire electrode is vibrated and deflected



- Measure the wire vibration
- Investigate the relation between wire vibration and timing of discharge occurrence



Method for measuring wire vibration



Intensity of light transduced voltage to V_1, V_2
Sensor output : $V = \frac{V_1 - V_2}{V_1 + V_2}$

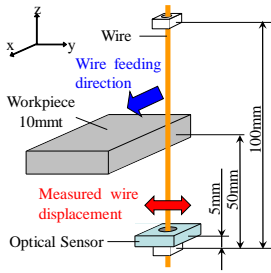
Features

- Resolution of $1\mu\text{m}$
- Compact size
- In-process measurement without disturbing process



Wire vibration synchronized with variation of discharge repetition rate

Experimental setup



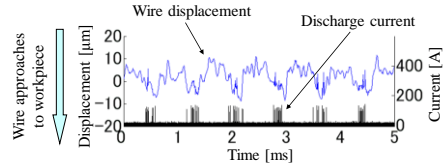
Machining conditions

Wire electrode	φ0.2 Brass
Workpiece	Steel 10mmt
Discharge current [A]	96
Pulse duration [μs]	0.65
Pulse interval [μs]	14.0
Open voltage [V]	80
Wire tension T [N]	10.78
Wire winding speed [m/min]	10.0
Machining speed [mm ³ /min]	10.0
Working fluid flow rate [l/min]	Upper 0 Lower 3
Depth of cut [μm]	0



Wire vibration synchronized with variation of discharge repetition rate

Measurement result



Discharge repetition rate increases synchronized with the approach of the wire to the workpiece



Fluctuation in amplitude caused by self-excited vibration

Self-excited vibration of wire electrode

Timing of discharge	Energy : Vibration	Amplitude
Wire departs from workpiece 	Gain : Excited 	Increase
Wire approaches to workpiece 	Lose : Suppressed 	Decrease



Conclusion

Cause of self-excited vibration

Discharge repetition rate increases when the wire approaches to the workpiece

↓ Action of bubble explosion force continues even after the end of discharge

Direction of the bubble explosion force is equal to that of the wire movement

↓ Wire gains a kinetic energy for every vibration cycle

Self-excited vibration of the wire electrode

