# ECE171A: Linear Control System Theory Discussion

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# MATLAB Polynomial Functions

- Consider:

$$p(s) = (s - 11.6219)(s + 0.3110 + 2.6704j)(s + 0.3110 - 2.6704j)$$

- poly: convert roots to polynomial coefficients:

```
r = [11.6219, -0.3110-2.6704i, -0.3110+2.6704i]
a = poly(r) = [1.0, -11.0, 0.0, -84.0]
```

- polyval: evaluate a polynomial, e.g., $p(1 - 2j)$:

```
polyval(a, 1-2i) = -62 + 46i
```

- roots: find polynomial roots:

```
roots(a) = [11.6219, -0.3110-2.6704i, -0.3110+2.6704i]
```

- conv: expand the product of two polynomials, e.g., $(3s^2 + 2s + 1)(s + 4)$:

```
conv([3, 2, 1], [1, 4]) = [3, 14, 9, 4]
```

# MATLAB Control System Functions

- SYS = tf(NUM,DEN): creates a continuous-time transfer function SYS with numerator NUM and denominator DEN:

```
dcmotor = tf(200,[1 1]);
```

- SYS = series(SYS1,SYS2): series connection of SYS1 and SYS2:

```
fwdsys = series(tf(200,[1 1]), tf(1,[1 8]));
```

- SYS = parallel(SYS1,SYS2): parallel connection of SYS1 and SYS2

```
fwdsys = parallel(tf(200,[1 1]), tf(1,[1 8]));
```

- SYS = feedback(SYS1, SYS2, sign): feedback connection of SYS1 and SYS2:

```
fbksys = feedback(series(tf(200,[1 1]), tf(1,[1 8])),tf(1,[0.25 1]))
```

# MATLAB Control System Functions

- SYS = zpk(Z,P,K) creates a continuous-time zero-pole-gain (zpk) model SYS with zeros Z, poles P, and gains K:

```
dcmotor = zpk([],[-1],200);
fbksys = zpk([-4],[-8.8426, -2.0787 + 1.7078i, -2.0787 -1.7078i],8);
```

- P = pole(SYS) returns the poles P of SYS:

```
sp = pole(fbksys) = [-8.8426, -2.0787 + 1.7078i, -2.0787 -1.7078i]
```

- [Z,G] = zero(SYS) computes the zeros Z and gain G of SYS:

```
[sz,k] = zero(fbksys) = [-4, 8]
```

- pzmap(SYS): computes and plots the poles and zeros of SYS

```
pzmap(fbksys)
```

# MATLAB Control System Functions

- Y = step(SYS,T): computes the step response Y of SYS at times T

```
t = 0:0.01:5;
step(fbksys,t);
```

- Y = impulse(SYS, T): computes the impulse response Y of SYS at times T

```
t = 0:0.01:5;
impulse(fbksys,t);
```

- Y = lsim(SYS,U,T): computes the output response Y of SYS with input U at times T

```
[u,t] = gensig('square',4,10,0.1);
lsim(fbksys,u,t);
```