USING SYSTEMMODELER AND MATHEMATICA TO RAPIDLY BUILD HARDWARE CONTROL SYSTEMS

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WHO IS AC KINETICS?

- INDEPENDENT ENGINEERING AND MOTION CONTROL DESIGN AND DEVELOPMENT COMPANY – ARMONK, NY
- MIT-TRAINED PHD SCIENTISTS, ENGINEERS AND DEVELOPERS
- TWENTY-FIVE YEARS OF EXPERIENCE DEVELOPING MACHINE AND VIBRATION CONTROL SOFTWARE

AC KINETICS EXPERIENCE

HISTORY OF SOFTWARE COMMERCIALIZATION, DEVELOPMENT, AND LICENSING (SINCE 1990)

- RESIDUAL VIBRATION REDUCTION – MOTORIZED EQUIPMENT
- ‘NO-SWAY’ CRANE CONTROL
- HARD DRIVE READ/WRITE SEEK TIMES AND ACOUSTICS
- DEVELOPED PROPRIETARY NON-LINEAR OPTIMIZATION TECHNIQUE
- DEVELOPED AC INDUCTION MOTOR CONTROL THAT SAVES ENERGY
- ENTERED INTO A JOINT DEVELOPMENT AGREEMENT WITH KOCH INDUSTRIES

LICENSEES OF PREVIOUS SOFTWARE

MAGNETEK

Agilent Technologies

Disney

PI
Physik Instrumente

Whiting
Crane Services

Quantum

NASA

ACS Tech80

DANAHER

Maxtor

SEAGATE

USED IN HUNDREDS OF MILLIONS OF MACHINES AND APPLICATIONS WORLDWIDE

OVERVIEW

- USAGE CASE: DEVELOPING, TESTING, AND VERIFYING REAL-TIME SOFTWARE IN SYSTEMMODELER
  - AC KINETICS MOTOR DRIVE HARDWARE
  - MODELING THE AC INDUCTION MOTOR SYSTEM
  - USE OF SYSTEMMODELER/MODELICA
  - VERIFICATION OF FIELD DATA AND SIMULATION DATA

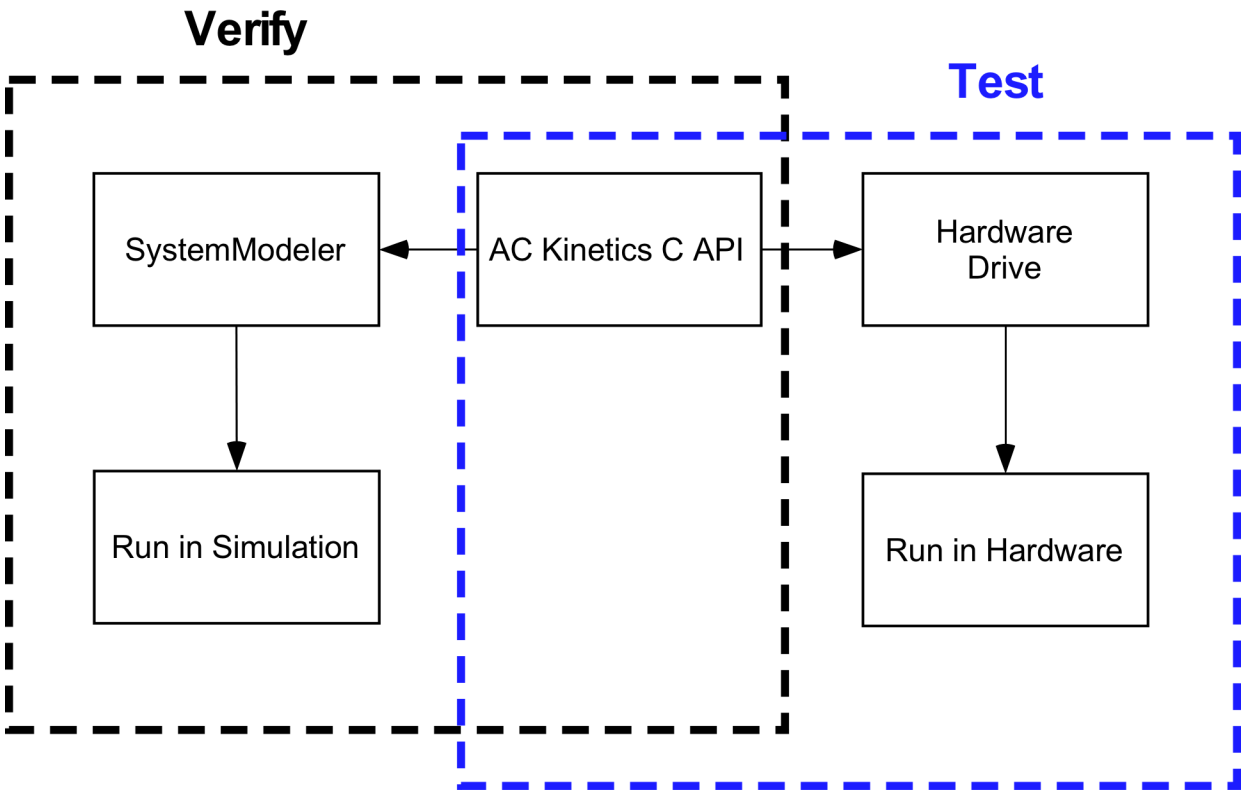
OVERVIEW (PART 2)

- NEW MATHEMATICA/WSM FUNCTIONALITY ENABLES
  - ADVANCED ANALYSIS
  - PROGRAMMATIC MODEL CONSTRUCTION
- SYSTEMMODELER (WSM) AND MODELICA ARE GREAT AT MODELING SYSTEMS
- WSM IS MOSTLY A SIMULATION PACKAGE
- MATHEMATICA ENABLES SYMBOLIC ANALYSIS AND PROGRAMMATIC

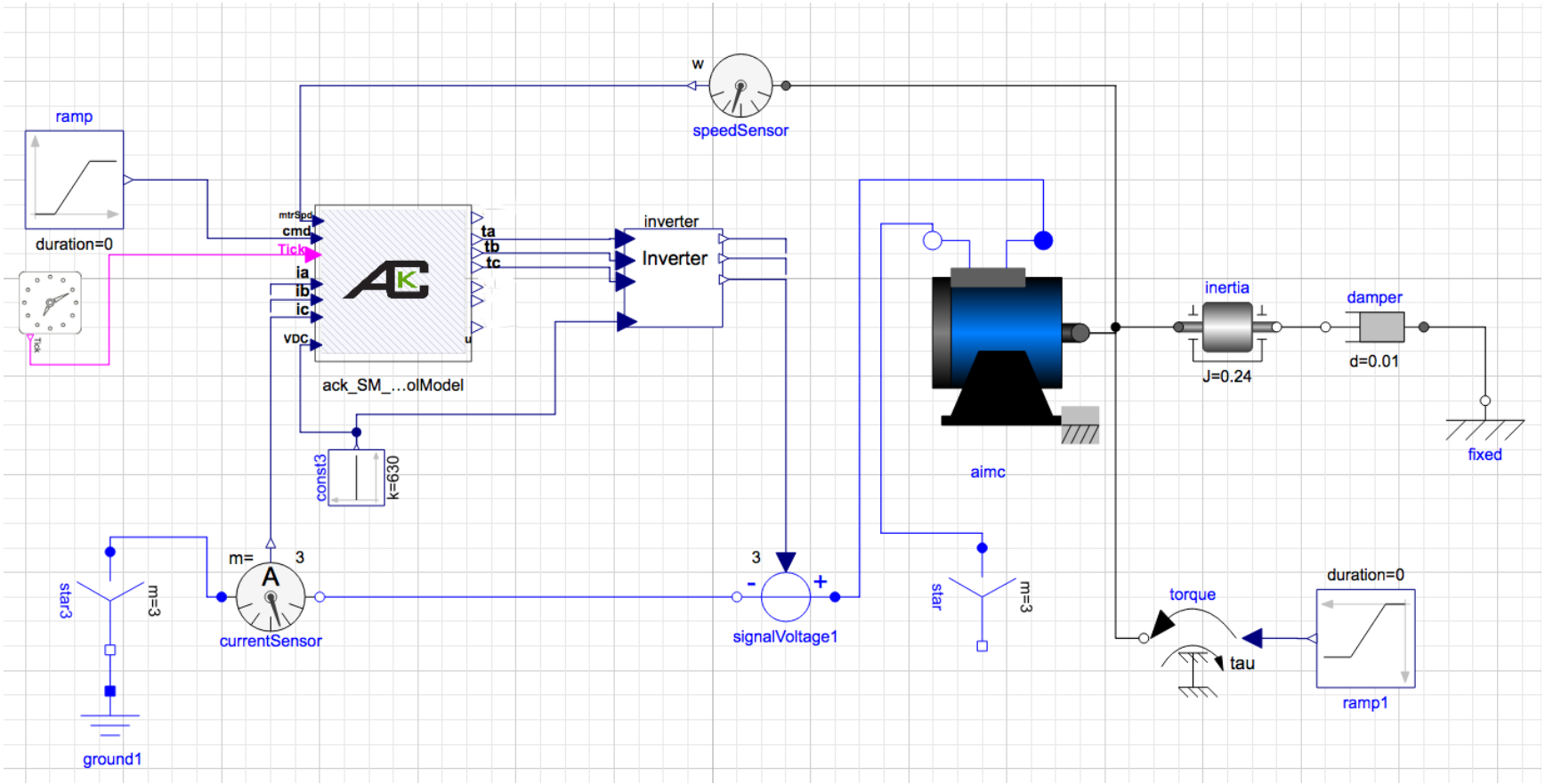
CASE STUDY – HOW AC KINETICS USES WSM/MODELICA IN ITS WORKFLOW

USAGE CASE 1: DEVELOPING, TESTING, AND VERIFYING REAL-TIME SOFTWARE IN SYSTEMMODELER

VERIFYING C CODE



SYSTEMMODELER MODEL



DISPENSED TOWEL WINDER TESTING

PAPER MILL (SAVANNAH RIVER) – HAND TOWEL (MAIN DRIVE)

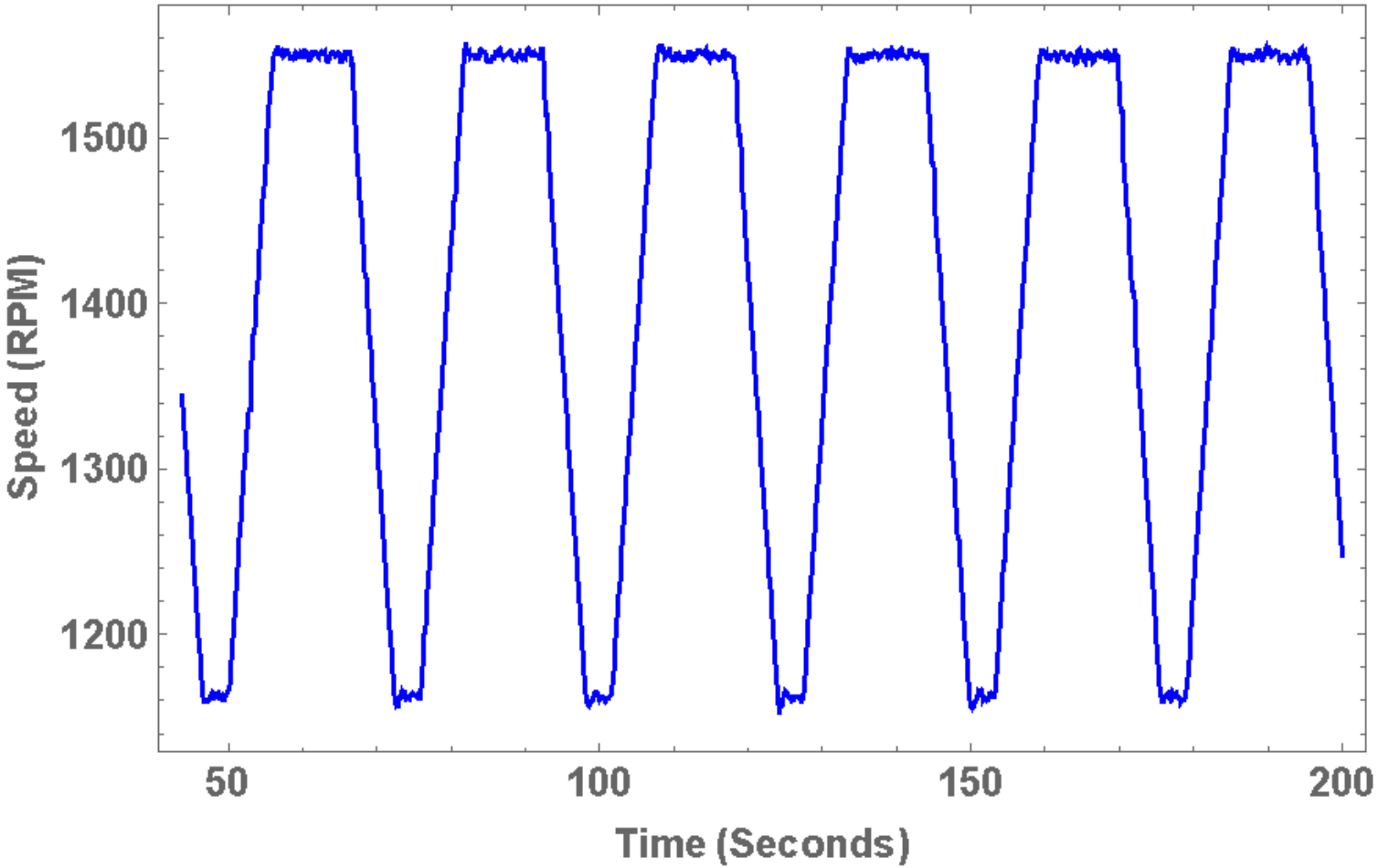
- CONFIGURED A MOTOR AND LOAD TO REPLICATE THE WINDER IN A NIST-CERTIFIED LABORATORY INCLUDING THE LARGE INERTIA OF WINDER'S MAIN SPINDLE (60HP MOTOR, 92.4% EFF)
- COMPLETED LAB TESTS UTILIZING FIELD-MEASURED TORQUE AND SPEED PROFILES
- ACK COMPARED TO EXISTING PRODUCTION DRIVE ON NORMAL HAND TOWEL WINDING OPERATION (INCLUDING

HAND TOWEL WINDER CONFIGURATION

MAIN PAPER ROLL SPINDLE (60HP) *FINISHED PRODUCT ROLLS*

60HP TOWEL WINDER – VELOCITY PROFILE

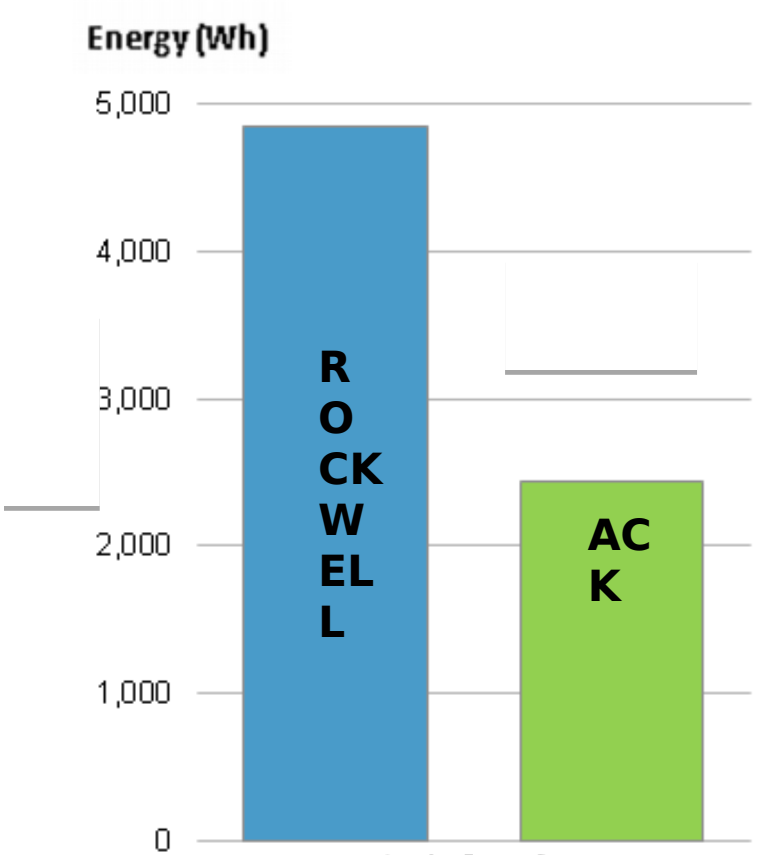
DYNAMIC LOAD (CHANGING PAPER ROLL DIAMETER)



SOURCE: ACK / GEORGIA PACIFIC FIELD TESTS – PRODUCTION WINDER DATA

60HP TOWEL WINDER EFFICIENCY

NEW DRIVE ECONOMICS (INCREMENTAL)



49% SAVINGS

(30-MINUTE CYCLE)

ANNUAL MOTOR POWER COST

(350 DAYS,$0.06/KWH):

$4,900

COMBINED EFFICIENCY GAIN:

49%

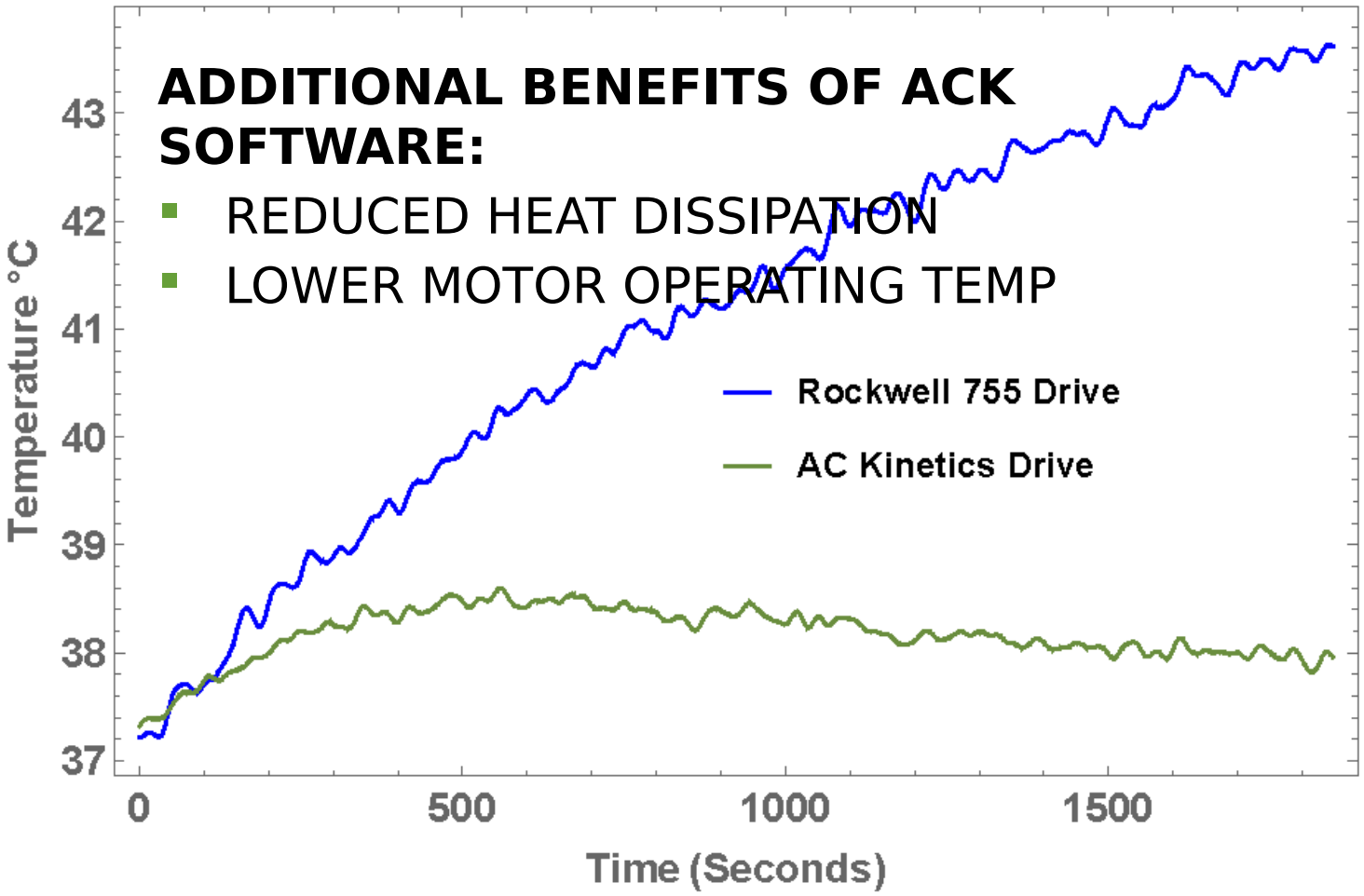
ANNUAL SAVINGS:

$2,400

SOURCE: ADVANCED ENERGY CERTIFIED TESTS – RALEIGH, NC

WINDER MOTOR (60HP) TEMP

30-MINUTE MACHINE PROCESS CYCLE



SOURCE: ADVANCED ENERGY CERTIFIED TESTS – RALEIGH, NC

CASE STUDY 2– USING WSM/MODELICA TO MODEL A SYSTEM AND USE MATHEMATICA TO DESIGN A CONTROLLER

USING NEW WSM-MATHEMATICA FUNCTIONALITY FOR A BETTER WORKFLOW

- QUICKLY CREATE A MODEL IN WSM/MODELICA
- EXTRACT THE EQUATIONS OF MOTION FROM A MODELICA MODEL
- USE THE EQUATIONS OF MOTION
  - CONTROLLER DESIGN
  - ANALYSIS/INSIGHT
  - LOAD CONTROLLER INTO SYSTEMMODELER

MMA/ WSM DEMONSTRATION

QUESTIONS?

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