# Emotionally Expressive Musical Performances
# MPE, ⊗MIDI 2 and Modeling

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# This Presentation Can be Found at:

## http://www.moforte.com/news

# About Pat

- 41 years in the Silicon Valley as an Engineer

- Built my first monophonic electronic instrument from a Radio Shack kit in 1970

- Gigged with an Arp Avatar guitar synth (1978)

- Computer modeling of vibrating strings and membranes for senior thesis in Physics (1982)

- Researcher in Physical Modeling at Stanford/CCRMA (1994)

- CEO/CTO of moForte, Chairman of the MPE Subcommittee MIDI Association, Stanford/CCRMA Visiting Scholar
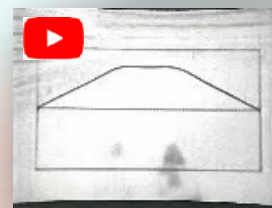
# MPE and ⋈**MIDI**2 Info

# What is MPE?

- MIDI Polyphonic Expression (MPE) makes it possible for artists to perform independent gestures for each musical note using three dimensions of expression. With MPE, every note a performer plays can be expressed individually, leading to more human, emotionally engaging performances.

- It's a set of conventions built on MIDI 1.0 to communicate per-note/per-row multidimensional (x|y|z) control data.

- MPE has legs! MPE has broad support from many DAWs, Synthesizers and Controllers, over 200 hardware and software products.

- Specs
  - The original spec was ratified in January-2018.
  - [A clarification revision was released April-2022](#):
  - [The MPE for MIDI 2 Profile was released April-2024](#)

# MPE Roots

- Derives from to how Guitar Controllers have used MIDI 1.0 for 35 years. CC-126 with Global Controllers is essentially MPE.  (Yamaha G10 1988)

- The Haken Continuum (x|y|z) expression (1999, Lippold Haken)

- The kBow and AIM (Keith McMillen, 2010, 2014)

- The LinnStrument is one of the first instruments to implement MPE (2014, Roger Linn and Geert Bevin)

- Roli adopted MPE for the original Seaboard (2014, Roland Lamb)
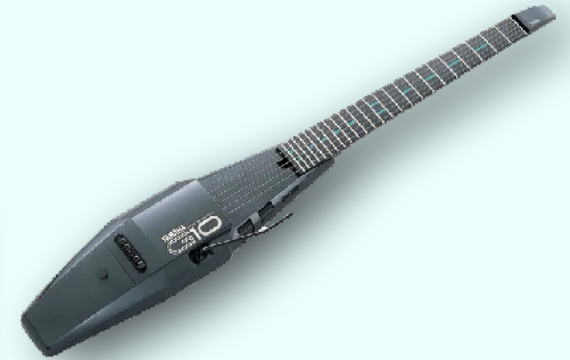
# MPE in a Nutshell

- Derives from to how Guitar Controllers have used MIDI 1.0 for past 35 years. CC-126 with Global Controllers is essentially MPE. (Yamaha G10 1988)

- Each note is on it's own channel (member channel), This means that expressive controls can be applied independently to individual notes. Configured with the MPE Configuration Message (MCM) RPN-6

- XYX Expression Control Conventions (per Channel)
    - KeyX – Pitch Bend (Roli calls this Glide)
    - KeyY – CC-74 (Roli calls this Slide)
    - KeyZ – Channel Pressure aka Channel Aftertouch (Roli calls this Press)

- Can be Channel-Per-Note, MIDI Mode 3, for Keyboards, like the Seaboard. Or Channel-Per-Row (String), MIDI Mode 4 for grid controllers like GeoShred, LinnStrument, Guitar Controller.

- Offers Manager Channel (typically 1 or 16) which globally controls the MPE Member Channels (ie modWheel for all Member Channels).

- Provides for a low/high split, and each split can have it's own Manager Channel (1 or 16).

KeyY = CC-74

KeyX = Pitch Wheel

KeyZ = Channel Pressure
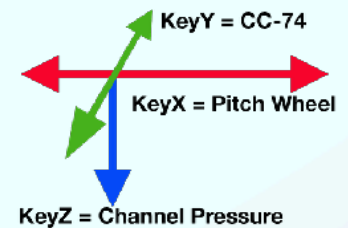
# ⋈ MIDI 2

- MIDI 2.0 is bidirectional. It changes MIDI from a monolog to a dialog, senders and receivers negotiate.

- MIDI 2.0 Protocol mirrors and extends the MIDI 1.0 Protocol.There is a new Universal MIDI Packet (UMP) which offers higher resolution performance controllers (32 bit), more controllers (32k) and 16 channel groups for 256 channels.

- MIDI-CI (Capability Inquiry) supports profile and property exchange which can be used to configure devices for specific applications.

- Compatible with MIDI 1.0

- Future Proofing, UMP is transport agnostic and can be implemented on USB, Ethernet, Bluetooth and future transport mechanisms.

- Already implemented for Linux, Android, Apple, Windows in 2024

# MPE in ꧁MIDI 2

- The Profile is receiver centric. The receiver reports the range of Channels that it can support, and the Sender adapts. Negotiation is done using Profile Details Inquiry.

- The MPE MCM parameter formerly sent by RPN-6 (MCM), is now handled by enabling an MPE Profile using MIDI CI.

- Two high resolution bipolar controllers are available as alternatives to Channel Pressure and Controller #74

- Multiple Zones are realized by enabling multiple MPE Profiles with non-overlapping Channels.

- May be used with MIDI 1 or MIDI 2 (UMP) messages.

# MPE in MIDI 2

MPE Sender

Profile Details
Inquiry Negotiaton

Sender and Receiver
use MIDI 1.0
messages

MPE Receiver

MIDI
1.0 ←→ 2.0
Translation

MIDI 2.0 Environment
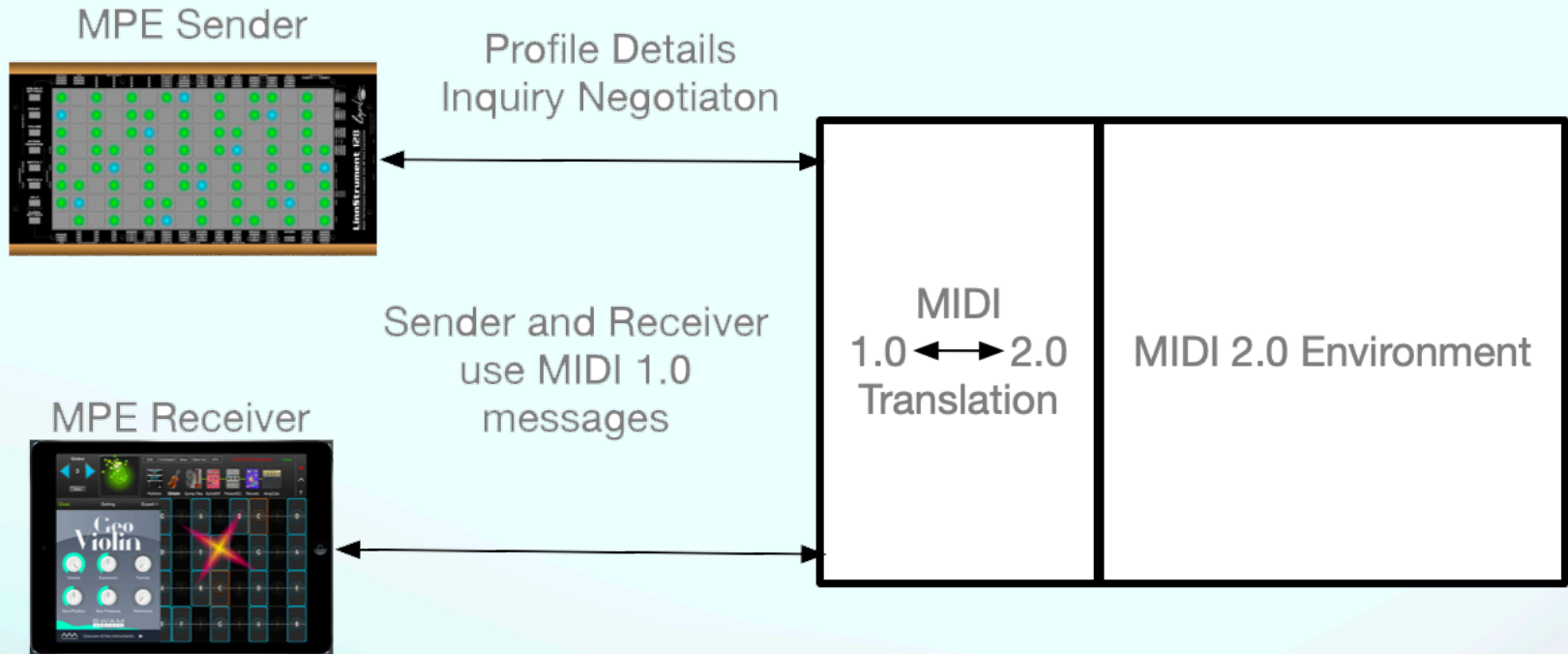
- MPE is a bridge between MIDI 1 and MIDI 2.

- MPE Products that implement the bidirectional MPE Profile Details Inquiry negotiation  in place of the unidirectional MIDI 1 MPE Configuration Message (MCM) are by definition using MIDI 2 and may communicate with MIDI 2 devices.

# Full Deck about ᗰ**MIDI** 2

ᗰ **MIDI**

## MIDI 2.0

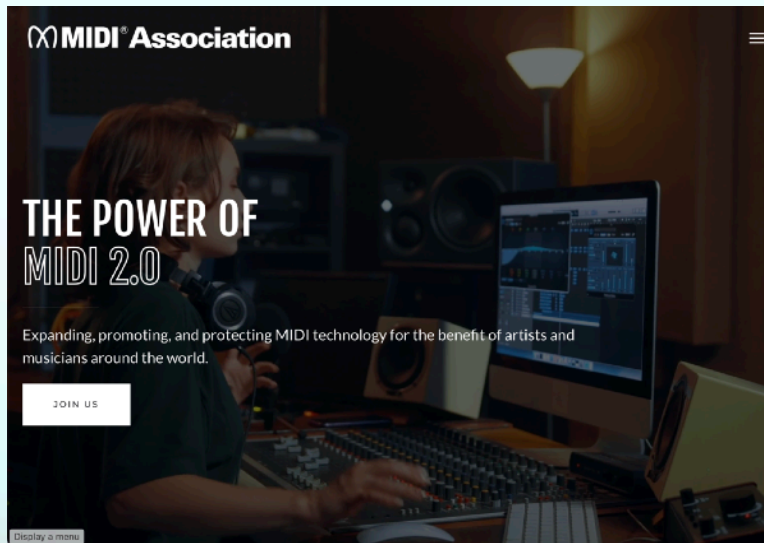**CCRMA Open House 2021, April 9, 2021**
**Gregory Pat Scandalis, Nick Porcaro, Julius Smith**

gps@ccrma.stanford.edu

https://www.moforte.com/midi-2-0/

# Where to Get Specs and Tools:
# [midi.org](midi.org) and [midi2.dev](midi2.dev)



- All specs and tools are available FREE
- You don't need to become a MIDI Association member access the specifications.

# MPE Enables Emotionally Expressive Musical Performances

# Modeling Synthesis + MPE



- Models are parameterized and as such can be musically expressive.

- Until recently, the options for expressing musical parameters were limited, *and affected all notes,* pitch wheel, mod wheel, knobs…

- **Together, the sum is greater than the parts**

# The Importance of Pitch Fluidity

- Pitch Fluidity is an essential expressive metaphor for musical performances around the world.  For example South Asian Music.

- MPE directly addresses Pitch Fluidity by supporting per-note multi octave pitch bending.

- Though **not a part of MPE, Pitch Rounding is essential to enable performers to play in-tune in any given temperament.**  Roli, Linnstrument, GeoShred, support pitch rounding.
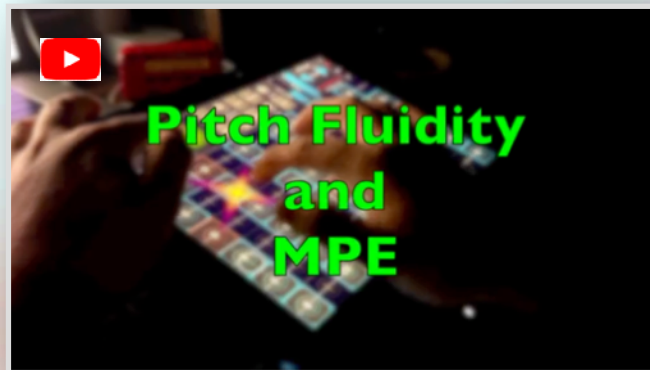
# About MIDI Modes 3 and 4

- MIDI Mode 3
    - Enabled with CC-127 (Poly Mode On)
    - Good for keyboards, Channel-Per-Note
    - Each channel is polyphonic
    - Legato can be challenging

- MIDI Mode 4
    - Enabled with CC-126 (Mono Mode On)
    - Good for row based controllers including guitar controllers, bowed string controllers Channel-Per-Row/String
    - Each Channel is Mono
    - Legato works well
    - Multi-timbral performances are possible

# Some MPE Controllers

- Haken Continuum
- Lumi Keys
- Roli Blocks
- KMI K-Board Pro 4
- Ere Touch
- Ableton Push 2
- Exquis
- Osmose
- Guitar Controllers
- Sensel Morph
- Artiphon INSTRUMENT 1
- Joué
- GeoShred
- Roli Seaboard
- LinnStrument

MPE makes a whole new generation of controllers possible. **Whatever instrument makers dream up!**

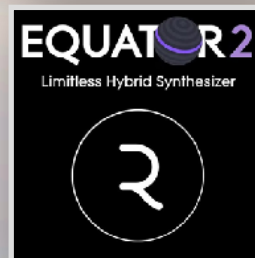AES Oct 2024

# Some MPE Modeled Synths
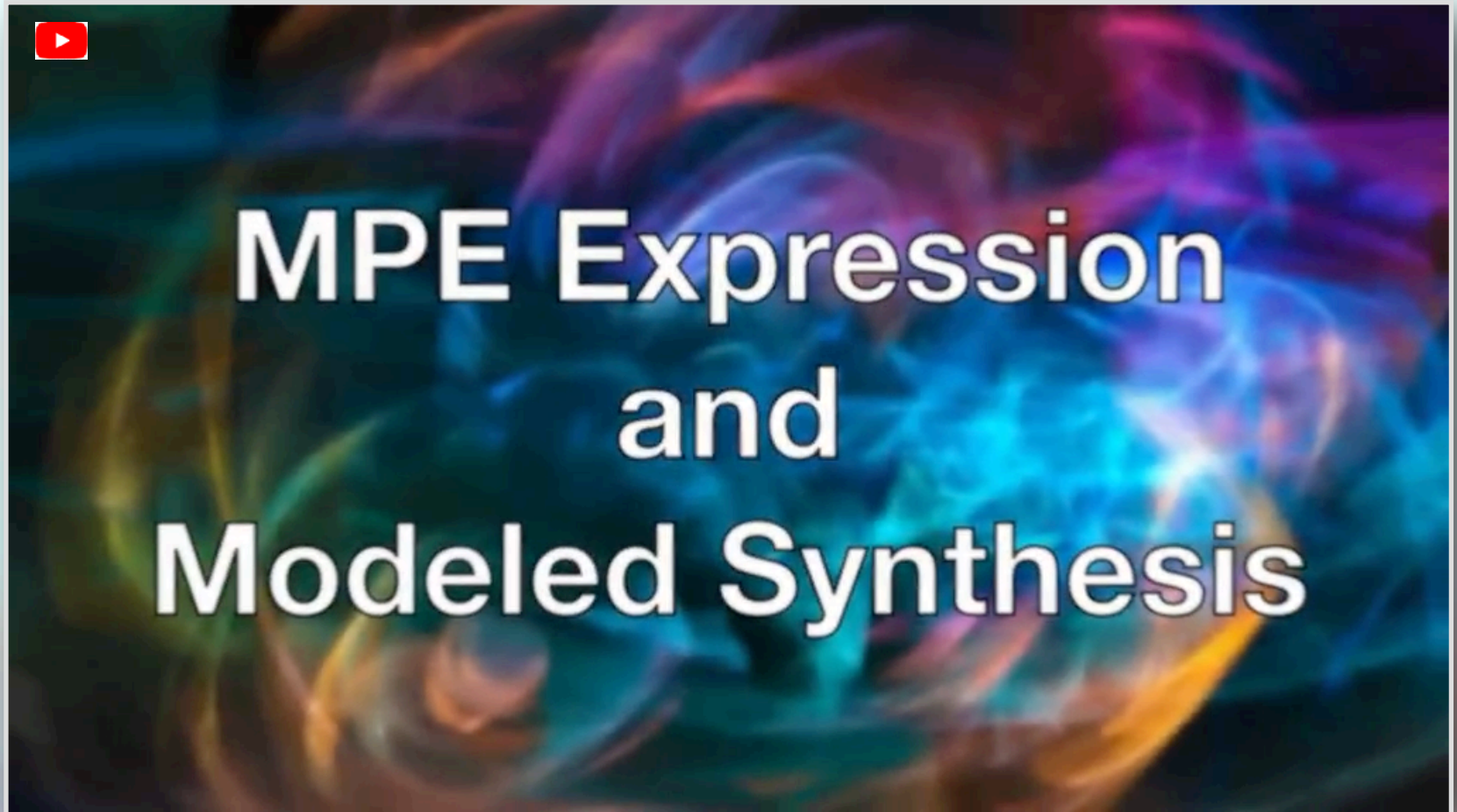
- Animoog Z
  Model-D
  Model 15
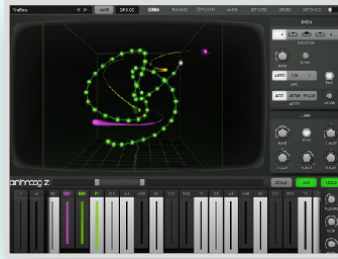


- SWAM



- Roger Linn's list of MPE sound sources

- GeoShred



- Roli's List of MPE Products

- Equator 2

# Demos

# Questions?

You can reach me at:

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# Gratitude

Mary Albertson
Eric Bateman
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Jon Dattorro
David Jaffe
Mike Kent
Joe Koepnick
Max Matthews (RIP)
Romain Michon
Denis Labrecque
Scott Levine
Roger Linn
Fernando Lopez-Lezcano

Keith McMillen (RIP)
Yann Orlarey
Stephane Letz
Stefano Lucato
Stanford OTL
Emanuele Parravicini
Danny Petkevich
Nick Porcaro
Bill Putnam
Jordan Rudess
Danielle Rudess
Kent Sandvik
Julius Smith
Tim Stilson
David Van Brink
Scott Van Duyne
Yamaha



And CCRMA